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TITLE: REFORMING DEVICE FOR FUEL CELL

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ABSTRACT:

PROBLEM TO BE SOLVED: To provide a fuel reformer having a short warming-up time, and prevent water vapor in a reformed gas from forming dew in a warming-up operation.

SOLUTION: Based on the detected temperature by a temperature detecting means 24 a control means 25 determine whether a warming-up operating condition or a stationary operating condition. In a warming-up operating condition S/C ratio of water-fuel mixed gas is lowered than that in the stationary operating condition by regulated supply means 12, 13. Thereby, the quantity of water supplied to a vaporization part 3 is decreased so that the heat quantity necessary for generating water-fuel mixed gas is little, thereby, the heat quantity for warming-up the vaporization part 3 is obtained more, and the warming up tinge of the fuel reformer 1 is reduced. When the water-fuel mixed gas is reformed to a reformed gas, the reformed gas does not have excessive water so that dew formation is prevented in the reformer, especially in a lead-out passage 41 in the downstream side of the reforming part 4 or equipment.

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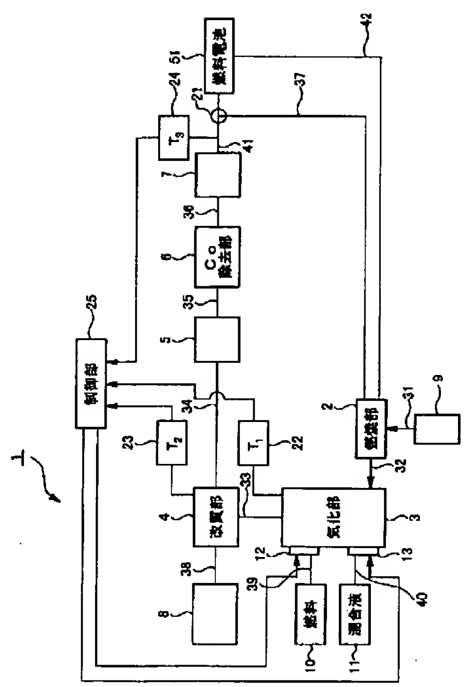
(54)【発明の名称】　燃料電池用燃料改質装置

(57)【要約】
【課題】　暖機運転時間が短く、暖機運転状態において改質ガス中の水蒸気が装置内で結露することがない燃料改質装置を提供する。
【解決手段】　温度検出手段24の検出温度に基づき、制御手段25が、暖機運転状態か定常運転状態かを判断し、暖機運転状態では、調整供給手段12、13によって水燃料混合ガスのS／C比を、定常運転状態におけるS／C比より低くする。これにより、気化部3への水の供給量が少なくなって水燃料混合ガスの生成に要する熱量が少なくて済み、そのため気化部3の暖機のための熱量をより大きくでき、燃料改質装置1の暖機時間を短縮することが可能になる。また、この水燃料混合ガスが改質されて改質ガスが生成しても、この改質ガス中に過剰な水蒸気が残存することがないので、暖機運転中に燃料改質装置内部、特に改質部4の下流側の導出流路41または機器において結露の発生を防止できる。



【特許請求の範囲】

【請求項１】　水及び炭化水素を含む原燃料を気化させて水燃料混合ガスを生成する気化部と、
前記水燃料混合ガスを改質して水素を含む改質ガスを生成する改質部を具備してなる燃料電池用燃料改質装置であって、
前記気化部に前記原燃料と前記水を供給すると共に前記水燃料混合ガス中の原燃料に対する水のモル比を調整する調整供給手段と、
前記改質部の下流側の導出流路または機器に設けられて、該導出流路または機器の温度を検出する温度検出手段と、
該温度検知手段の検出温度に基づいて、前記調整供給手段を制御する制御手段とを備えてなることを特徴とする燃料電池用燃料改質装置。

【請求項２】　前記調整供給手段は、原燃料を前記気化部に供給する第１供給部と、原燃料と水の混合液を前記気化部に供給する第２供給部とからなり、
前記制御手段は、前記検出温度が定常運転可能温度以下の時に、前記第１供給部及び前記第２供給部から前記原燃料及び前記混合液を前記気化部に供給させ、
前記検出温度が定常運転可能温度を越えたときに、前記第１供給部による原燃料の供給を停止させるものであることを特徴とする請求項１記載の燃料電池用燃料改質装置。

【請求項３】　前記気化部の熱源となる燃焼ガスを生成する燃焼部と、前記導出流路の途中から分岐して、前記燃焼部に前記改質ガスを供給するバイパス通路と、この導出通路とバイパス通路の分岐部分に配置された流路切替弁とを備え、
前記検出温度が定常運転可能温度以下の時に、前記改質ガスを前記バイパス通路を経て前記燃焼部に供給するように構成されたことを特徴とする請求項１または請求項２に記載の燃料電池用燃料改質装置。

【請求項４】　水及び原燃料を気化させて水燃料混合ガスを生成し、この水燃料混合ガスを改質して改質ガスを生成する燃料電池用燃料改質装置であって、前記改質ガスが供給される導出流路または機器の温度を検出し、この検出温度が定常運転温度以下の暖機運転状態の時に、前記水燃料混合ガス中の原燃料に対する水のモル比を、燃料改質装置の定常運転状態におけるモル比より低く制御し、　検出温度が定常運転温度を越えた定常運転状態になったときに、前記水燃料混合ガス中の原燃料に対する水のモル比を、前記暖機運転状態におけるモル比より高く制御するように構成されたことを特徴とする燃料電池用燃料改質装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、燃料電池用燃料改質装置に関するものであり、特に、暖機時間を短かくできる燃料電池用燃料改質装置に関するものである。

【０００２】

【従来の技術】固体高分子型の燃料電池は、アノード及びカソードで高分子電解質膜を挟んでなるスタックセルを具備してなるもので、アノードに燃料である水素、カソードに酸素をそれぞれ供給して電気化学反応を起こして発電するようになっている。アノードで発生した水素イオンは、高分子電解質膜を通過してカソードに移動するので、高分子電解質膜のイオン導伝性を保つために高分子電解質膜に水を供給する必要がある。

【０００３】ところで、従来から燃料電池の水素供給源としては、燃料改質装置が用いられている。この燃料改質装置は、炭化水素系化合物またはアルコール系化合物等の原燃料と水とを気化して水燃料混合ガスを形成し、これを改質触媒を用いて改質することにより、水素（燃料）を含む改質ガスを生成するものである。そして、この燃料改質装置は、燃料電池の高分子電解質膜に水を供給するために、改質ガスに過剰の水蒸気を含ませるようになっている。

【０００４】この従来の燃料電池用燃料改質装置を図面を参照して説明する。図３には従来の燃料改質装置１０１の構成図を示す。この燃料改質装置１０１は、燃焼ガスを発生させる燃焼部１０２と、前記燃焼ガスの熱により原燃料と水の混合液を気化して水燃料混合ガスを生成する気化部１０３と、改質触媒を備えて前記水燃料混合ガスをこの改質触媒により改質して水素を含む改質ガスを生成する改質部１０４と、選択酸化触媒を備えて、前記改質ガス中に副成した一酸化炭素をこの選択酸化触媒により酸化除去する一酸化炭素除去部１０５（以下、ＣＯ除去部と記載する）と、始動燃焼部１０６とを主体として構成されている。

【０００５】燃焼部１０２には、燃焼用触媒が備えられると共に燃焼用燃料タンク１０７が取り付けられている。また、気化部１０３には、噴射装置１０９が取り付けられ、この噴射装置１０９には、配管１１０を介して混合液タンク１０８が取り付けられている。混合液タンク１０８には、原燃料と水の混合液が充填されている。原燃料としては、例えばメタノール等のアルコール系化合物、メタン、エタン、ガソリン等の炭化水素系化合物が用いられる。また、始動燃焼部１０６には、燃焼用触媒が備えられると共に始動燃焼用燃料と空気とを供給する図示しない供給装置が取り付けられている。また、ＣＯ除去部１０５には、配管１１１を介して固体高分子型の燃料電池５１が接続されている。

【０００６】次に、燃料電池用燃料改質装置１０１を始動して定常運転状態に至るまでの動作を説明する。まず、始動燃焼部１０６にて始動用燃料を燃焼し、発生した始動燃焼ガスを配管１１２を介して改質部１０４に送り、改質部１０４及びＣＯ除去部１０５を暖機する。同時に、燃焼部１０２にて燃焼用燃料を燃焼し、発生した

燃焼ガスを配管１１３を介して気化部１０３に送り、気化部１０３を暖機する。

【０００７】そして、改質部１０４の改質触媒の温度が約２００℃に達すると共に気化部１０３の温度が水燃料混合ガスを気化させ得る温度（約２００℃）に達した時点で、始動燃焼部１０６への始動燃料の供給を停止すると共に、混合液を混合液タンク１０８から噴射装置１０９に供給して混合液を気化部１０３内に噴射し、燃焼部１０２から供給された燃焼ガスの熱によって混合液を気化して水燃料混合ガスを生成する。

【０００８】そして配管１１４を介してこの水燃料混合ガスを改質部１０４に送る。改質部１０４では水燃料混合ガスが送られると同時に始動燃焼部１０６から空気が供給され、改質部１０４に備えられた改質触媒によって、水蒸気と酸素の存在下で原燃料が改質されて水素を含む改質ガスが生成する。改質ガスは、配管１１３を介してＣＯ除去部１０５に送られ、ＣＯ除去部１０５において改質ガス中に副成した一酸化炭素を選択酸化触媒にて酸化除去する。そして、配管１１１を介して改質ガスを燃料電池５１に供給する。

【０００９】この燃料改質装置１０１においては、水燃料混合ガスの原燃料に対する水のモル比（以下、Ｓ／Ｃ比と記載する）を１．５～２．５の範囲に設定して、水燃料混合ガス中の水蒸気のモル量を、改質反応における水の理論反応モル量（モル比で、原燃料（メタノール）：水＝１：１）より過剰とすることにより、改質反応後においてこの過剰分の水蒸気を改質ガス中に残存させ、この過剰分の水蒸気を含む改質ガスを燃料電池５１に供給することにより、燃料電池５１の高分子電解質膜に水を供給できるようになっている。

【００１０】

【発明が解決しようとする課題】しかし、従来の燃料電池用燃料改質装置１０１においては、水燃料混合ガスのＳ／Ｃ比を高くするために気化部１０３内に噴射する水の量が多くなり、水の気化熱が原燃料であるメタノールの気化熱より高いため、水燃料混合ガスを生成するためにより多くの熱量が必要となり、これにより気化部１０３を暖機するための熱量が少なくなって、燃料改質装置１０１の暖機に長時間を要するという課題があった。

【００１１】また、従来の燃料電池用燃料改質装置１０１においては、改質部１０４及びＣＯ除去部１０５の暖機を始動燃焼部１０６により行うが、ＣＯ除去部１０５が改質部１０４よりも下流側に設けられているため、改質部１０４が暖機されて燃料改質装置１０１が運転状態に達した時点においても、ＣＯ除去部１０５及びその下流側にある配管１１１が十分に暖機されず、例えばこれらの温度が８０℃以下である場合がある。この状態で水蒸気を含む改質ガスがＣＯ除去部１０５及び配管１１１を通過すると、ＣＯ除去部１０５及び配管１１１にて水蒸気が結露して水が滞留し、この水により選択酸化触媒の触媒能が低下して一酸化炭素の除去効率が低下したり、改質ガスの流路が閉塞されてしまうという課題があった。

【００１２】本発明は、上記の課題を解決するためになされたものであって、暖機運転時間が短く、暖機運転状態において改質ガス中の水蒸気が装置内で結露することがない燃料電池用燃料改質装置を提供することを目的とする。

【００１３】

【課題を解決するための手段】上記の目的を達成するために、本発明は以下の構成を採用した。本発明の燃料電池用燃料改質装置は、水及び炭化水素を含む原燃料を気化させて水燃料混合ガスを生成する気化部（実施形態では気化部３）と、前記水燃料混合ガスを改質して水素を含む改質ガスを生成する改質部（実施形態では改質部４）を具備してなる。また、この燃料改質装置は、前記気化部に前記原燃料と前記水を供給すると共に前記水燃料混合ガス中の原燃料に対する水のモル比（以下，Ｓ／Ｃ比と記載する）を調整する調整供給手段（実施形態では第１、第２噴射装置１２、１３）と、前記改質部の下流側の導出流路（実施形態では導出配管４１）または機器に設けられて、該導出流路または機器の温度を検出する温度検出手段（実施形態では第３温度計２４）と、該温度検出手段の検出温度に基づいて、前記調整供給手段を制御する制御手段（実施形態では制御部２５）とを備えてなる。ここで、「前記改質部の下流側の機器」とは、改質部の下流側に設けられる熱交換器、一酸化炭素除去部（以下、ＣＯ除去部と記載する）、補助燃焼装置、その他必要に応じて設けられる機器をいう。更に、原燃料としては、例えばメタノール等のアルコール系化合物、メタン、エタン、ガソリン等の炭化水素系化合物等を挙げることができる。

【００１４】かかる燃料改質装置によれば、温度検出手段の検出温度に基づいて、制御手段が、燃料改質装置が暖機運転状態であるか定常運転状態であるかを判断し、燃料改質装置が暖機運転状態のときには、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低くする。すると、気化部への水の供給量が少なくなって水燃料混合ガスの生成に要する熱量が少なくて済み、そのため気化部の暖機のための熱量をより大きくでき、燃料改質装置の暖機時間を短縮することが可能になる。また、暖機運転状態の時に、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低くすると、この水燃料混合ガスが改質されて改質ガスが生成しても、この改質ガス中に過剰な水蒸気が残存することがないので、暖機運転中に燃料改質装置内部、特に改質部の下流側の導出流路または機器において、結露が発生することがない。

【００１５】なお、燃料改質装置の暖機運転状態における前記水燃料混合ガスの原燃料に対する水蒸気のモル比

（以下、Ｓ／Ｃ比と記載する）は、０．７～１．２の範囲であることが好ましく、定常運転状態における水燃料混合ガスのＳ／Ｃ比は、１．５～２．５の範囲であることが好ましい。

【００１６】また、前記調整供給手段は、原燃料を前記気化部に供給する第１供給部（実施形態では第１噴射装置１２）と、原燃料と水の混合液を前記気化部に供給する第２供給部（実施形態では第２噴射装置１３）とからなる。そして、前記制御手段は、前記検出温度が定常運転可能温度以下の時に、前記第１供給部及び前記第２供給部から前記原燃料及び前記混合液を前記気化部に供給させ、前記検出温度が定常運転可能温度を越えたときに、前記第１供給部による原燃料の供給を停止させるものである。

【００１７】ここでの「定常運転可能温度」とは、改質ガスに含まれる水蒸気が、改質部の下流側の導出通路または機器にて結露しない温度とされ、具体的には７０℃～８０℃とされる。制御手段は、前記検出温度が定常運転可能温度以下の時は、燃料改質装置が暖機運転状態にあると判断し、定常運転可能温度を越えた時は、燃料改質装置が定常運転状態であると判断する。

【００１８】この燃料電池用燃料改質装置の調整供給手段は、制御手段によって制御されていて、燃料改質装置が暖機運転状態のときには原燃料と混合液とを気化部に供給し、燃料改質装置が定常運転状態のときには混合液のみを気化部に供給することにより、暖機運転状態における水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低くし、定常運転状態における水燃料混合ガスのＳ／Ｃ比を、暖機運転状態におけるＳ／Ｃ比より高くする。このようにして、気化部に供給される原燃料と水の割合を容易に変更でき、水燃料混合ガスのＳ／Ｃ比を容易に調整することが可能になる。

【００１９】更に本発明の燃料電池用燃料改質装置は、前記気化部の熱源となる燃焼ガスを生成する燃焼部（実施形態では燃焼部２）と、前記導出流路の途中から分岐して、前記燃焼部に前記改質ガスを供給するバイパス通路（実施形態ではバイパス配管３７）と、この導出通路とバイパス通路の分岐部分に配置された流路切替弁（実施形態では三方コック２１）とを備えている。そして、前記検出温度が定常運転可能温度以下の時に、前記改質ガスを前記バイパス通路を経て前記燃焼部に供給するように構成されている。かかる燃料改質装置によれば、暖機運転状態の時に、改質ガスを燃焼部に供給して燃焼するので、燃焼部及び気化部を更に暖機することが可能となる。また、暖機運転時に生成される改質ガスは、水蒸気量が少ないので、燃焼される際に発生する熱量が高くなり、燃焼部及び気化部を更に暖機することが可能となる。

【００２０】本発明の燃料電池用燃料改質装置は、水及び原燃料を気化させて水燃料混合ガスを生成し、この水燃料混合ガスを改質して改質ガスを生成する燃料改質装置であって、前記改質ガスが供給される導出流路または機器の温度を検出し（実施形態ではステップＳ１６）、この検出温度が定常運転温度以下の暖機運転状態の時に（実施形態ではステップＳ２０）、前記水燃料混合ガスのＳ／Ｃ比を、燃料改質装置の定常運転状態におけるＳ／Ｃ比より低く制御し（実施形態ではステップＳ２１、Ｓ２２）、検出温度が定常運転温度を越えた定常運転状態になったときに（実施形態ではステップＳ１７）、前記水燃料混合ガスのＳ／Ｃ比を、前記暖機運転状態におけるＳ／Ｃ比より高く制御する（実施形態ではステップＳ１８、Ｓ１９）ように構成されたことを特徴とする。

【００２１】かかる燃料改質装置によれば、暖機運転状態のときに、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低く制御するので、気化部への水の供給量が少なくなって水燃料混合ガスの生成に要する熱量が少なくて済み、そのため燃料改質装置の暖機のための熱量をより大きくでき、燃料改質装置の暖機時間を短縮させることが可能になる。また、暖機運転状態のときに、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低く制御するので、この水燃料混合ガスが改質されて改質ガスが生成しても、この改質ガス中に過剰な水蒸気が残存することがなく、燃料改質装置内部、特に改質部の下流側の導出流路または機器において、結露を発生させることがない。

【００２２】また、本発明の燃料電池用燃料改質装置は、前記水燃料混合ガスを生成するに際して、前記暖機運転状態では、該水燃料混合ガスを生成する気化部に対し、原燃料を供給する一方、原燃料と水の混合液を供給し（実施形態ではステップＳ２１、Ｓ２２）、前記定常運転状態では、前記暖機運転時の原燃料の供給を停止して、前記混合液を供給する（実施形態ではステップＳ１８、Ｓ１９）ように構成されたこを特徴とする。

【００２３】かかる燃料改質装置によれば、暖機運転状態のときに、原燃料と混合液とを気化部に供給し、定常運転状態になったときに、混合液のみを気化部に供給するので、暖機運転状態における水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低くし、定常運転状態における水燃料混合ガスのＳ／Ｃ比を、暖機運転状態におけるＳ／Ｃ比より高くする。このようにして、気化部に供給される原燃料と水の割合を容易に変更でき、水燃料混合ガスのＳ／Ｃ比を容易に調整することが可能になる。

【００２４】

【発明の実施の形態】以下、本発明の実施形態である燃料電池用燃料改質装置を図面を参照して説明する。図１には本発明の燃料電池用燃料改質装置１の構成図を示す。この燃料改質装置１は、燃焼ガスを発生させる燃焼部２と、前記燃焼ガスの熱により原燃料と水の混合液を気化して水燃料混合ガスを生成する気化部３と、前記水

燃料混合ガスを改質して水素を含む改質ガスを生成する改質部4と、前記改質ガス中に副成した一酸化炭素を酸化除去するCO除去部6と、始動燃焼部8とを主体として構成されている。

【0025】燃焼部2には図示しない燃焼用触媒が備えられると共に燃焼用燃料タンク9が取り付けられている。燃焼用燃料タンク9から燃焼部2に供給された燃焼用燃料が、燃焼用触媒上にて燃焼され、このとき発生する燃焼ガスが気化部3に供給される。

【0026】気化部3には、第1供給部である第1噴射装置12と、第2供給部である第2噴射装置13とが取り付けられ、第1噴射装置12には配管39を介して燃料タンク10が取り付けられ、第2噴射装置13には配管40を介して混合液タンク11が取り付けられている。これら第1噴射装置12（第1供給部）及び第2噴射装置13（第2供給部）により調整供給手段が構成さ＊れている。この調整供給手段は、気化部3に原燃料と水を供給すると共に水燃料混合ガス中の原燃料に対する水のモル比（以下、S／C比と記載する）を調整するものである。燃料タンク10には原燃料が充填され、混合液タンク11には原燃料と水の混合液が充填されている。原燃料としては、例えばメタノール等のアルコール系化合物、メタン、エタン、ガソリン等の炭化水素系化合物等を挙げることができる。

【0027】改質部4には、改質触媒が備えられており、この改質触媒は200℃以上に加熱されていて、水燃料混合ガスが空気中の酸素と共にこの改質部4に供給されると、改質触媒上にて以下の反応式（1）〜（3）に示される反応が進行して、改質ガスが生成する。なお、この反応式（1）〜（3）では、原燃料としてメタノールを用いた場合の反応を示している。

【0028】

$$CH_3OH + H_2O \rightarrow 3H_2 + CO_2 \quad \cdots(1)$$

$$CH_3OH + 2O_2 \rightarrow 2H_2O + CO_2 \quad \cdots(2)$$

$$CH_3OH \rightarrow 2H_2 + CO \quad \cdots(3)$$

【0029】反応式（1）は、原燃料であるメタノールと水による改質反応であって水素（H_2）が生成し、反応式（2）は、メタノールの酸化反応であって水（H_2O）が生成し、反応式（3）は、メタノールの分解反応であり、微量の一酸化炭素（CO）が生成する。改質反応（反応式（1））は吸熱反応であって外部からの熱の供給が必要とされ、メタノールの酸化（反応式（2））により発生する酸化熱によりこれを補う。このようにして、水素（燃料）、水蒸気（水）及び一酸化炭素を含む改質ガスが生成する。

【0030】この燃料改質装置1は、定常運転時には、水燃料混合ガスの原燃料と水のモル比（以下、S／C比と記載する）を1．5〜2．5の範囲に設定することにより、水燃料混合ガス中の水蒸気量を、改質反応における水の理論反応モル量（モル比で、原燃料（メタノール）：水＝1：1）より過剰として、改質反応後においてこの過剰分の水蒸気を改質ガス中に残存させ、この過剰分の水蒸気を含む改質ガスを燃料電池51に供給することにより、燃料電池51の高分子電解質膜に水を供給できるようになっている。

【0031】始動燃焼部8には、図示しない燃焼用触媒が備えられると共に始動燃焼用燃料と空気とを供給する図示しない供給装置が取り付けられている。また、改質部4とCO除去部6の間、即ち改質部4の下流側には、配管34を介して熱交換器5が取り付けられ、CO除去部6の下流側には、配管36を介して熱交換器7が取り付けられている。さらに熱交換器7の下流側には導出配管41を介して固体高分子型の燃料電池51が接続されている。

【0032】熱交換器5は、改質部4から供給された改質ガスを冷却する。熱交換器5を設けた理由は、改質部※4から出た改質ガスは200℃以上に加熱されており、後段のCO除去部6の作動温度が100〜150℃程度であるために、改質ガスを100℃程度に冷却する必要があるからである。CO除去部6には、図示しない選択酸化触媒が備えられており、この選択酸化触媒は100℃程度に加熱されていて、改質ガス中の一酸化炭素がこの選択酸化触媒により酸化されて二酸化炭素が生成することにより、改質ガス中の一酸化炭素が除去される。熱交換器7は、CO除去部6から供給された改質ガスを冷却する。熱交換器7を設けた理由は、改質ガスはCO除去部6を出た時点で150〜200℃に加熱されており、後段の燃料電池51の作動温度が80〜130℃程度であるために、改質ガスを80℃程度に冷却する必要があるからである。

【0033】熱交換器7を通過した改質ガスは、導出配管41を介して燃料電池51に供給され、改質ガス中の水素（燃料）と、別途供給された酸素とが電気化学反応を起こして発電が行われる。また、燃料電池51から燃焼部2に至る配管42が設けられていて、燃料電池51から排出された未反応ガスを含む排出ガスを燃焼部2に供給し、燃焼部2にて未反応ガスを燃焼できるようになっている。

【0034】また、気化部3には第1温度計22が、改質部4には第2温度計23が、導出配管41には温度検知手段である第3温度計24がそれぞれ取り付けられていて、これら第1、2、3温度計22、23、24は制御部25に接続されている。また、制御部25には、第1、2供給部である第1、2噴射装置12、13が接続されている。この制御部25は、第3温度計24の検出温度に基づいて、調整供給手段である第1、2噴射装置12、13を制御するものであり、検出温度が定常運転

可能温度以下の時に、第１、２噴射装置１２、１３から原燃料及び混合液を気化部３に供給させ、検出温度が定常運転可能温度を越えたときに、第１噴射装置１２による原燃料の供給を停止させるものである。ここで定常運転可能温度とは、改質ガスに含まれる水蒸気が、改質部４の下流側の導出通路４１にて結露しない温度とされ、具体的には７０℃～８０℃とされる。

【００３５】また、導出配管４１には、バイパス管３７が分岐して取り付けられている。このバイパス管３７は燃焼部２に接続されている。そして、配管４１とバイパス配管３７の分岐部分には、三方バルブ２１が取り付けられている。この三方バルブ２１は制御部２５に接続されている。

【００３６】次に、燃料電池用燃料改質装置１の制御部２５の動作を説明するために、図１及び図２を参照して、燃料改質装置１の始動から定常運転状態に至るまでの動作を説明する。まず、ステップＳ１において、制御部２５内にあるメモリがイニシャル値にセットされ、三方バルブ２１により導出配管４１とバイパス配管３７とが連結される。次にステップＳ２において、第１、第２、第３温度計２２、２３、２４の各検出温度T_1、T_2、T_3が読み込まれる。

【００３７】次にステップＳ３において、改質部４の温度を検出する第２温度計２３の検出温度T_2が改質開始温度T_yを越えたか否かを、制御部２５内の改質開始温度判定部において判定する。改質開始温度T_yは、改質触媒にて改質反応が進行する活性化温度とされ、１８０～２５０℃の範囲で設定される。検出温度T_2が改質開始温度T_yを越えた場合には、ステップＳ４において、改質開始温度判定フラグＦ２に「１」が入力され、検出温度T_2が改質開始温度T_y以下である場合には、ステップＳ６において、改質開始温度判定フラグＦ２に「０」が入力される。

【００３８】改質開始温度判定フラグＦ２が「０」である場合、ステップＳ７において、始動燃焼部８に始動用燃料と空気が供給されて始動用燃料が燃焼され、発生した始動燃焼ガスが配管３８を介して改質部４及びその下流側に送られ、改質部４、熱交換器５、７、ＣＯ除去部６、配管３４、３５、３６及び導出配管４１が暖機される。

【００３９】次にステップＳ８において、気化部３の温度を検出する第１温度計２２の検出温度T_1が気化開始温度T_xを越えたか否かを、制御部２５内の気化開始温度判定部において判定する。気化開始温度T_xは、水及び原燃料を瞬時に気化させることが可能な温度とされ、１５０～２５０℃の範囲で設定される。検出温度T_1が気化開始温度T_xを越えた場合には、ステップＳ９において、気化開始温度判定フラグＦ１に「１」が入力され、検出温度T_1が気化開始温度T_y以下である場合には、ステップＳ１１において、気化開始温度判定フラグＦ１に「０」が入力される。

【００４０】気化開始温度判定フラグＦ１が「０」である場合、ステップＳ１２において、燃焼部２にて燃焼用燃料が燃焼されて燃焼ガスが発生し、この燃焼ガスが配管３２を介して気化部３及びその下流側に送られ、気化部３、改質部４、熱交換器５、７、ＣＯ除去部６、配管３４、３５、３６及び導出配管４１が暖機される。

【００４１】次にステップＳ１３において、導出配管４１の温度を検出する第３温度計２４の検出温度T_3が定常運転開始温度T_zを越えたか否かを、制御部２５内の定常運転開始温度判定部において判定する。定常運転可能温度T_zは、改質ガスに含まれる水蒸気が、導出通路４１にて結露しない温度とされ、具体的には７０℃～８０℃とされる。検出温度T_3が定常運転開始温度T_zを越えた場合には、ステップＳ１４において、定常運転開始温度判定フラグＦ３に「１」が入力され、検出温度T_3が定常運転開始温度T_z以下である場合には、ステップＳ１５において、定常運転開始温度判定フラグＦ３に「０」が入力される。

【００４２】次に、ステップＳ１６において、気化開始温度判定フラグＦ１、改質開始温度判定フラグＦ２、定常運転開始温度判定フラグＦ３の各入力値を、制御部２５の定常運転判定部において判定する。気化開始温度判定フラグＦ１、改質開始温度判定フラグＦ２、定常運転開始温度判定フラグＦ３のいずれか１つの入力値が「０」である場合（Ｆ１＊Ｆ２＊Ｆ３＝０の場合）、燃料改質装置１が暖機運転状態であると判断し、ステップＳ２０に進む。

【００４３】ステップＳ２０において、暖機運転モードが選択され、暖機運転が継続される。　具体的には、制御部２５から第１、２噴射装置１２、１３に動作信号が送られ、ステップＳ２１において第１噴射装置１２から原燃料が気化部３に供給される共にステップＳ２２において第２噴射装置１３から混合液が供給されて、水燃料混合ガスが生成し、改質部４、熱交換器５、７、ＣＯ除去部６、配管３４、３５、３６及び導出配管４１の暖機が継続される。また、水燃料混合ガスが三方コック２１を経てバイパス配管３７から燃焼部２に送られ、水燃料混合ガス中の水素が燃焼されて燃焼部２が暖機される。

【００４４】このとき生成された水燃料混合ガスのＳ／Ｃ比は、０．７～１．２の範囲とされる。そして、改質部４には、この水燃料混合ガスが改質部４に送られると共に、始動燃焼部８から空気（酸素）が送られ、改質触媒上にて前述の反応式（１）～（３）に示した反応が進行し、水素を含む改質ガスが生成する。

【００４５】このとき生成する改質ガスは、水燃料混合ガスのＳ／Ｃ比が０．７～１．２の範囲とされていて、改質部４に供給される水蒸気のモル量が、改質反応における水の理論反応モル量（モル比で、原燃料（メタノール）：水＝１：１）とほぼ等しくなるために、改質反応

後において水蒸気が改質ガス中に残存することがなく、改質部の下流側にある熱交換器５、７、ＣＯ除去部６、配管３４、３５、３６及び導出配管４１の温度が低くても、これらの配管若しくは機器内部で水蒸気の結露が発生することがない。

【００４６】このようにして暖機運転が継続され、第１、第２、第３温度計２２、２３、２４の各検出温度T_1、T_2、T_3が次第に上昇する。

【００４７】次に、再びステップＳ２に戻り、第１、第２、第３温度計２２、２３、２４の各検出温度T_1、T_2、T_3が読み込まれる。次にステップＳ３において、第２温度計２３の検出温度T_2が改質開始温度T_yを越えたか否かを、制御部２５内の改質開始温度判定部において再度判定する。

【００４８】第２温度計２３の検出温度T_2が改質開始温度T_yを越えて、改質開始温度判定フラグＦ２が「１」とされると（ステップＳ４）、ステップＳ５において、始動燃焼部８への始動用燃料の供給が停止される。これにより、始動燃焼部８の燃焼が停止するが、空気のみが供給されており、この空気は配管３８を介して改質部４に送られる。

【００４９】次にステップＳ８において、第１温度計２２の検出温度T_1が気化開始温度T_xを越えたか否かを、制御部２５内の気化開始温度判定部において再度判定する。第１温度計２２の検出温度T_1が気化開始温度T_xを越えて、気化開始温度判定フラグＦ１が「１」とされると（ステップＳ９）、ステップＳ１０において、燃焼部２への燃焼用燃料の供給が停止される。

【００５０】次にステップＳ１３において、第３温度計２４の検出温度T_3が定常運転開始温度T_zを越えたか否かを、制御部２５内の定常運転開始温度判定部において再度判定する。第３温度計２４の検出温度T_3が定常運転開始温度T_zを越えると、定常運転開始温度判定フラグＦ３が「１」とされ（ステップＳ１４）、ステップＳ１６に進む。

【００５１】ステップＳ１６において、気化開始温度判定フラグＦ１、改質開始温度判定フラグＦ２、定常運転開始温度判定フラグＦ３の各入力値を、制御部２５の定常運転判定部において再度判定する。気化開始温度判定フラグＦ１、改質開始温度判定フラグＦ２、定常運転開始温度判定フラグＦ３の全ての入力値が「１」である場合（Ｆ１＊Ｆ２＊Ｆ３＝１の場合）、燃料改質装置１が暖機運転状態から定常運転状態に至ったと判断され、ステップＳ１７に進む。

【００５２】ステップＳ１７において、定常運転モードが選択され、定常運転が開始される。　具体的には、制御部２５から第１噴射装置１２に停止信号が送られ、第１噴射装置１２からの原燃料の気化部３への供給が停止させる一方（ステップＳ１８）、第２噴射装置１３からの混合液の供給を継続させ（ステップＳ１９）て水燃料混合ガスを生成させる。また、三方バルブ２１が切り替えられて、導出配管４１が燃料電池５１に連結される。このとき生成された水燃料混合ガスのＳ／Ｃ比は、１．５～２．５の範囲とされる。そして、改質部４には、この水燃料混合ガスが改質部４に送られると共に、始動燃焼部８から空気（酸素）が送られ、改質触媒上にて前述の反応式（１）～（３）に示した反応が進行し、水素を含む改質ガスが生成する。このとき生成する改質ガスは、水燃料混合ガスのＳ／Ｃ比が１．５～２．５の範囲とされているために、改質部４に供給される水蒸気のモル量が、改質反応における水の理論反応モル量（モル比で、原燃料（メタノール）：水＝１：１）より過剰となり、改質反応後においてこの過剰分の水蒸気が改質ガス中に残存することになる。この過剰分の水蒸気を含む改質ガスがＣＯ除去部６及び三方バルブ２１を経て燃料電池５１に供給されて、燃料電池５１の高分子電解質膜に水が供給される。

【００５３】なお、このとき（定常運転状態）の水燃料混合ガスのＳ／Ｃ比が１．５以下であると、水蒸気量が低下し、改質ガス中に残存する水蒸気量が減少して、燃料電池５１の高分子電解質膜に十分な水を供給できなくなるので好ましくなく、Ｓ／Ｃ比が２．５を越えると、水蒸気量が多くなって、改質ガス中に必要以上の水蒸気が残存し、改質部４の下流側の配管または機器若しくは燃料電池５１に水が滞留してしまうので好ましくない。

【００５４】また、導出配管４１の温度は、既に水蒸気が結露しない温度（定常運転可能温度）まで上昇しているので、導出配管４１の内部で水蒸気が結露することがない。また、導出配管４１の温度が定常運転可能温度まで上昇していれば、その上流側にある熱交換器５、７、ＣＯ除去部６、配管３４、３５、３６の温度は、当然に導出配管４１よりも高い温度まで上昇しているので、これらの配管若しくは機器の内部にて水蒸気が結露することがない。

【００５５】

【発明の効果】以上説明したように、本発明の燃料電池用燃料改質装置は、気化部に原燃料と水を供給すると共に水燃料混合ガスのＳ／Ｃ比を調整する調整供給手段と、導出流路または機器の温度を検出する温度検出手段と、該温度検出手段の検出温度に基づいて、前記調整供給手段を制御する制御手段とが備えられており、制御手段が、燃料改質装置が暖機運転状態であるか定常運転状態であるかを判断し、燃料改質装置が暖機運転状態のときには、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低くするので、気化部への水の供給量が少なくなって水燃料混合ガスの生成に要する熱量が少なくて済み、そのため気化部の暖機のための熱量をより大きくでき、燃料改質装置の暖機時間を短縮することができる。また、暖機運転状態の時に、水燃料混合ガスのＳ／Ｃ比を、定常運転状態におけるＳ／Ｃ比より低く

すると、この水燃料混合ガスが改質されて改質ガスが生成しても、この改質ガス中に過剰な水蒸気が残存することがないので、暖機運転中に燃料改質装置内部、特に改質部の下流側の導出流路または機器において、結露の発生を防止することができる。

【0056】また、この燃料電池用燃料改質装置の調整供給手段は、制御手段によって制御されていて、燃料改質装置が暖機運転状態のときには原燃料と混合液とを気化部に供給し、燃料改質装置が常運転状態のときには混合液のみを気化部に供給することにより、暖機運転状態における水燃料混合ガスのS／C比を、定常運転状態におけるS／C比より低くし、定常運転状態における水燃料混合ガスのS／C比を、暖機運転状態におけるS／C比より高くするので、気化部に供給される原燃料と水の割合を容易に変更でき、水燃料混合ガスのS／C比を容易に調整することができる。

【0057】更に、本発明の燃料電池用燃料改質装置は、前記導出流路の途中から分岐して、前記燃焼部に前記改質ガスを供給するバイパス通路が備えられ、前記検出温度が定常運転可能温度以下の時に、前記改質ガスを前記バイパス通路を経て前記燃焼部に供給するように構成されているので、暖機運転状態の時に、改質ガスを燃焼部に供給して燃焼することができ、燃焼部及び気化部を更に暖機することが可能となって、暖機運転時間をより短縮できる。また、暖機運転時に生成される改質ガスは、水蒸気量が少ないので、燃焼される際に発生する熱量が高くなり、燃焼部及び気化部を更に暖機することが可能となる。

【0058】本発明の燃料電池用燃料改質装置は、改質ガスが供給される導出流路または機器の温度を検出し、この検出温度が定常運転温度以下の暖機運転状態の時に、前記水燃料混合ガスのS／C比を、定常運転状態におけるS／C比より低くさせるので、気化部への水の供給量が少なくなって水燃料混合ガスの生成に要する熱量が少なくて済み、そのため燃料改質装置の暖機のための熱量をより大きくでき、燃料改質装置の暖機時間を短縮させることができる。また、この水燃料混合ガスが改質されて改質ガスが生成しても、この改質ガス中に過剰な水蒸気が残存することがなく、燃料改質装置内部、特に改質部の下流側の導出流路または機器において、結露の発生を防止できる。

【0059】更に、検出温度が定常運転温度を越えた定常運転状態になったときに、前記水燃料混合ガスのS／C比を、前記暖機運転状態におけるS／C比より高く制御するので、改質ガス中に過剰の水蒸気を残存させることができる。

【図面の簡単な説明】

【図1】　本発明の実施形態である燃料電池用燃料改質装置の構成を示す構成図である。

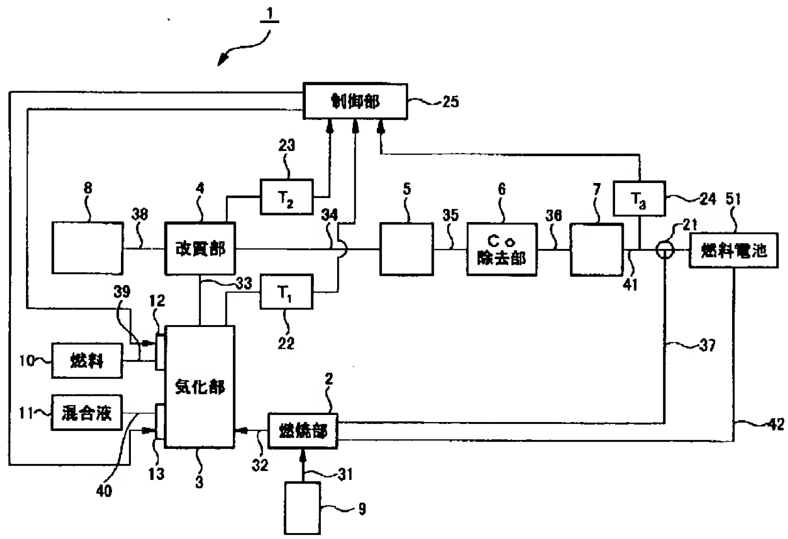
【図2】　本発明の実施形態である燃料電池用燃料改質装置の制御部の動作を説明するためのフローチャートである。

【図3】　従来の燃料電池用燃料改質装置の構成を示す構成図である。

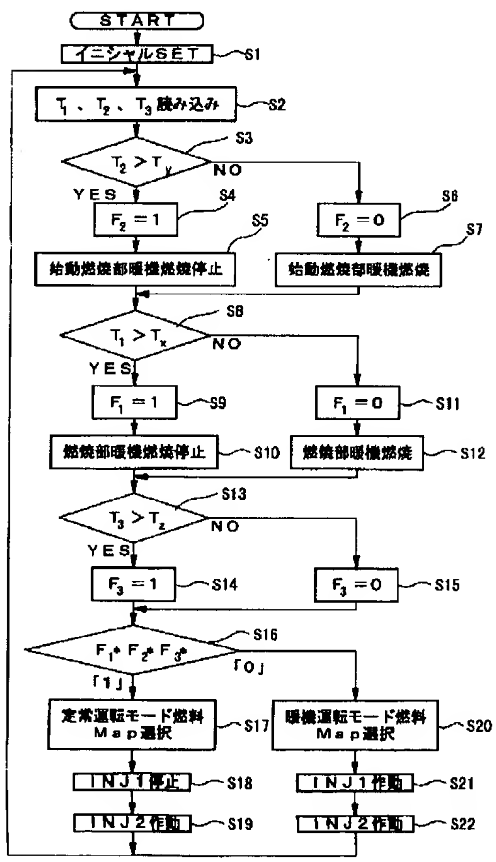
【符号の説明】

1…燃料電池用燃料改質装置、2…燃焼部、3…気化部、4…改質部、5、7…熱交換器、6…ＣＯ除去部、8…始動燃焼部、12…第１噴射装置（第１供給部）、13…第２噴射装置（第２供給部）、21…三方コック（流路切替弁）、22…第１温度計、23…第２温度計、24…第３温度計（温度検出手段）、25…制御部（制御手段）、37…バイパス配管（バイパス通路）、41…導出配管（導出通路）、51…燃料電池

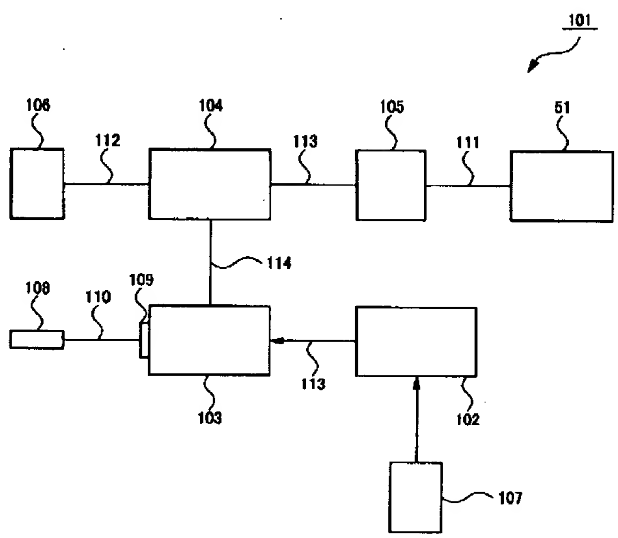
【図１】


1
制御部
25
23
T2
8
38
4
改質部
34
5
35
6
Co
除去部
36
7
T3
24
51
燃料電池
21
41
33
T1
22
39
12
10
燃料
気化部
37
2
11
混合液
燃焼部
42
40
13
3
32
31
9

【図２】


START
イニシャルSET
S1
T1、T2、T3読み込み
S2
T2 > Ty
S3
NO
YES
F2 ＝1
S4
F2 ＝0
S6
始動燃焼部暖機燃焼停止
S5
始動燃焼部暖機燃焼
S7
T1 > Tx
S8
NO
YES
F1 ＝1
S9
F1 ＝0
S11
燃焼部暖機燃焼停止
S10
燃焼部暖機燃焼
S12
T3 > Tz
S13
NO
YES
F3 ＝1
S14
F3 ＝0
S15
F1* F2* F3*
S16
「0」
「1」
定常運転モード燃料
Map選択
S17
暖機運転モード燃料
Map選択
S20
INJ1停止
S18
INJ1作動
S21
INJ2作動
S19
INJ2作動
S22

【図３】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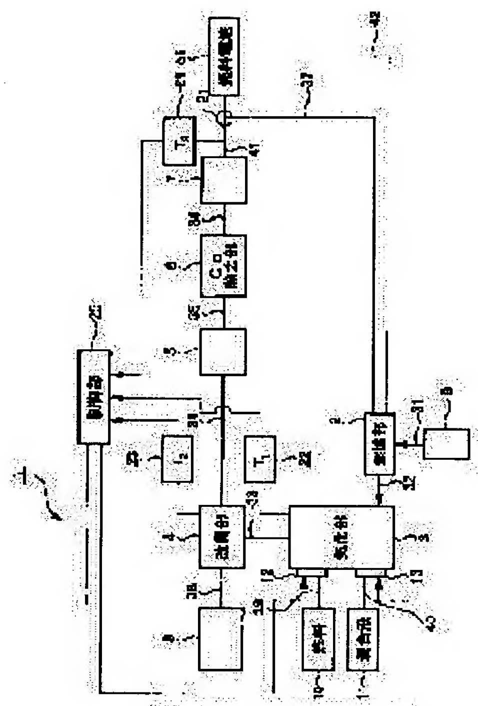
(54) REFORMING DEVICE FOR FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel reformer having a short warming-up time, and prevent water vapor in a reformed gas from forming dew in a warming-up operation.

SOLUTION: Based on the detected temperature by a temperature detecting means 24 a control means 25 determine whether a warming-up operating condition or a stationary operating condition. In a warming-up operating condition S/C ratio of water-fuel mixed gas is lowered than that in the stationary operating condition by regulated supply means 12, 13. Thereby, the quantity of water supplied to a vaporization part 3 is decreased so that the heat quantity necessary for generating water-fuel mixed gas is little, thereby, the heat quantity for warming-up the vaporization part 3 is obtained more, and the warming up tinge of the fuel reformer 1 is reduced. When the water-fuel mixed gas is reformed to a reformed gas, the reformed gas does not have excessive water so that dew formation is prevented in the reformer, especially in a lead-out passage 41 in the downstream side of the reforming part 4 or equipment.



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[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] The evaporation section which is made to evaporate the original fuel containing water and a hydrocarbon, and generates water fuel mixed gas, It is the fuel reformer for fuel cells which comes to provide the reforming section which generates the reformed gas which reforms said water fuel mixed gas and contains hydrogen. An adjustment supply means to adjust the mole ratio of water to the original fuel in said water fuel mixed gas while supplying said Hara fuel and said water to said evaporation section, The fuel reformer for fuel cells characterized by it being prepared in the derivation passage or the device of the downstream of said reforming section, and coming to have a temperature detection means to detect the temperature of this derivation passage or a device, and the control means which controls said adjustment supply means based on the detection temperature of this temperature detection means.
[Claim 2] Said adjustment supply means consists of the 1st feed zone which supplies a original fuel to said evaporation section, and a original fuel and the 2nd feed zone which supplies the mixed liquor of water to said evaporation section. Said control means When said detection temperature is below the temperature that can be operated steadily, said Hara fuel and said mixed liquor are made to supply to said evaporation section from said 1st feed zone and said 2nd feed zone and said detection temperature exceeds the temperature which can be operated steadily The fuel reformer for fuel cells according to claim 1 characterized by being what stops supply of the original fuel by said 1st feed zone.
[Claim 3] It branches from the combustion section which generates the combustion gas used as the heat source of said evaporation section, and the middle of said derivation passage. It has the passage selector valve arranged at a part for the tee of the bypass path which supplies said reformed gas to said combustion section, and a this derivation path and a bypass path. The fuel reformer for fuel cells according to claim 1 or 2 characterized by being constituted so that said reformed gas may be supplied to said combustion section through said bypass path when said detection temperature is below the temperature that can be operated steadily.
[Claim 4] It is the fuel reformer for fuel cells which is made to evaporate water and a original fuel, generates water fuel mixed gas, reforms this water fuel mixed gas and generates reformed gas. Detect the temperature of the derivation passage to which said reformed gas is supplied, or a device, and when this detection temperature is the warming-up operational status below steady operation temperature The mole ratio of water to the original fuel in said water fuel mixed gas is controlled lower than the mole ratio in the steady operation condition of a fuel reformer. When detection temperature changes into the steady operation condition beyond steady operation temperature The fuel reformer for fuel cells characterized by being constituted so that the mole ratio of water to the original fuel in said water fuel mixed gas may be controlled more highly than the mole ratio in said warming-up operational status.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel reformer for fuel cells which can short-**** warming-up time amount especially about the fuel reformer for fuel cells.
[0002]
[Description of the Prior Art] The fuel cell of a solid-state macromolecule mold comes to provide the stack cel which comes to insert the polyelectrolyte film with an anode and a cathode, supplies oxygen to an anode at the hydrogen and the cathode which are a fuel, respectively, causes electrochemical reaction, and generates it. Since the hydrogen ion generated with the anode passes the polyelectrolyte film and moves to a cathode, in order to maintain the ion conductivity of the polyelectrolyte film, it needs to supply water to the polyelectrolyte film.
[0003] By the way, as a hydrogen source of supply of a fuel cell, the fuel reformer is used from the former. This fuel reformer generates the reformed gas containing hydrogen (fuel) by evaporating a original fuel and water, such as a hydrocarbon system compound or an alcoholic system compound, forming water fuel mixed gas, and reforming this using a reforming catalyst. And this fuel reformer includes a superfluous steam in reformed gas, in order to supply water to the polyelectrolyte film of a fuel cell.
[0004] This conventional fuel reformer for fuel cells is explained with reference to a drawing. The block diagram of the conventional fuel reformer 101 is shown in drawing 3 . The combustion section 102 which this fuel reformer 101 makes generate combustion gas, The evaporation section 103 which evaporates the mixed liquor of a original fuel and water with the heat of said combustion gas, and generates water fuel mixed gas, The reforming section 104 which generates the reformed gas which is equipped with a reforming catalyst, reforms said water fuel mixed gas according to this reforming catalyst, and contains hydrogen, It has a selective oxidation catalyst and the carbon monoxide removal section 105 (it is hereafter indicated as CO removal section) which carries out oxidation removal of the carbon monoxide which sub**(ed) in said reformed gas according to this selective oxidation catalyst, and the starting combustion section 106 are constituted as a subject.
[0005] While having a catalyst for combustion, the fuel tank 107 for combustion is attached in the combustion section 102. Moreover, a fuel injection equipment 109 is attached in the evaporation section 103, and the mixed liquor tank 108 is attached in this fuel injection equipment 109 through piping 110 at it. The mixed liquor tank 108 is filled up with the mixed liquor of a original fuel and water. As a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, are used, for example. Moreover, while having a catalyst for combustion, the feeder which supplies the fuel for starting combustion and air and which is not illustrated is attached in the starting combustion section 106. Moreover, the fuel cell 51 of a solid-state macromolecule mold is connected to CO removal section 105 through piping 111.
[0006] Next, actuation until it puts the fuel reformer 101 for fuel cells into operation and results in a steady operation condition is explained. First, warming up of delivery, the reforming section 104, and

the CO removal section 105 is carried out for the starting combustion gas which burned and generated the fuel for starting in the starting combustion section 106 to the reforming section 104 through piping 112. Warming up of delivery and the evaporation section 103 is carried out for the combustion gas which burned and generated the fuel for combustion in the combustion section 102 to coincidence through piping 113 at the evaporation section 103.
[0007] And while the temperature of the reforming catalyst of the reforming section 104 amounts to about 200 degrees C, when the temperature of the evaporation section 103 reaches the temperature (about 200 degrees C) which may make water fuel mixed gas evaporate While suspending supply of the prime fuel to the starting combustion section 106, mixed liquor is supplied to a fuel injection equipment 109 from the mixed liquor tank 108, mixed liquor is injected in the evaporation section 103, with the heat of the combustion gas supplied from the combustion section 102, mixed liquor is evaporated and water fuel mixed gas is generated.
[0008] And this water fuel mixed gas is sent to the reforming section 104 through piping 114. In the reforming section 104, air is supplied from the starting combustion section 106 at the same time water fuel mixed gas is sent, and the reformed gas which reforming of the original fuel is carried out under existence of a steam and oxygen by the reforming catalyst with which the reforming section 104 was equipped, and contains hydrogen according to it generates. Reformed gas is sent to CO removal section 105 through piping 113, and carries out oxidation removal of the carbon monoxide which sub**(ed) in reformed gas in CO removal section 105 with a selective oxidation catalyst. And reformed gas is supplied to a fuel cell 51 through piping 111.
[0009] In this fuel reformer 101, the mole ratio (it is hereafter indicated as a S/C ratio) of water to the original fuel of water fuel mixed gas is set as the range of 1.5-2.5. Theoretical reaction molar quantity of water [in / for the molar quantity of the steam in water fuel mixed gas / a reforming reaction] (by the mole ratio) Original fuel (methanol) : by making the steam for this excess remain in reformed gas after a reforming reaction, and supplying the reformed gas containing the steam for this excess to a fuel cell 51 by supposing that it is more superfluous than water =1:1 Water can be supplied now to the polyelectrolyte film of a fuel cell 51.
[0010]
[Problem(s) to be Solved by the Invention] However, it sets to the conventional fuel reformer 101 for fuel cells. Since it is higher than the heat of vaporization of the methanol whose heat of vaporization of water the amount of the water injected in the evaporation section 103 increases in order to make high the S/C ratio of water fuel mixed gas, and is a original fuel, In order to generate water fuel mixed gas, many heating values were needed, the heating value for carrying out warming up of the evaporation section 103 by this decreased, and the technical problem that warming up of the fuel reformer 101 took long duration occurred.
[0011] Moreover, in the conventional fuel reformer 101 for fuel cells, although the starting combustion section 106 performs warming up of the reforming section 104 and CO removal section 105 Since CO removal section 105 is formed in the downstream rather than the reforming section 104, When warming up of the reforming section 104 is carried out and the fuel reformer 101 reaches operational status, warming up of the piping 111 in CO removal section 105 and its downstream may not fully be carried out, for example, such temperature may be 80 degrees C or less. When the reformed gas which contains a steam in this condition passed CO removal section 105 and piping 111, the steam dewed for CO removal section 105 and piping 111, water piled up, and the technical problem that the catalyst ability of a selective oxidation catalyst falls with this water, the removal effectiveness of a carbon monoxide will fall or the passage of reformed gas will be blockaded occurred.
[0012] This invention is made in order to solve the above-mentioned technical problem, and warming-up operation time is short and it aims at offering the fuel reformer for fuel cells which the steam in reformed gas does not dew within equipment in warming-up operational status.
[0013]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention adopted the following configurations. The fuel reformer for fuel cells of this invention comes to provide the

evaporation section (an operation gestalt evaporation section 3) which is made to evaporate the original fuel containing water and a hydrocarbon, and generates water fuel mixed gas, and the reforming section (an operation gestalt reforming section 4) which generates the reformed gas which reforms said water fuel mixed gas and contains hydrogen. Moreover, an adjustment supply means to adjust the mole ratio (for it to be hereafter indicated as a S/C ratio) of water to the original fuel in said water fuel mixed gas while this fuel reformer supplies said Hara fuel and said water to said evaporation section (an operation gestalt the 1st and 2nd fuel injection equipment 12 and 13), A temperature detection means for it to be prepared in the derivation passage (the operation gestalt derivation piping 41) or the device of the downstream of said reforming section, and to detect the temperature of this derivation passage or a device (an operation gestalt the 3rd thermometer 24), Based on the detection temperature of this temperature detection means, it comes to have the control means (an operation gestalt control section 25) which controls said adjustment supply means. Here, "the device of the downstream of said reforming section" means the heat exchanger prepared in the downstream of the reforming section, the carbon monoxide removal section (it is hereafter indicated as CO removal section), an auxiliary burner, and the other devices prepared if needed. Furthermore, as a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, etc. can be mentioned, for example.
[0014] According to this fuel reformer, based on the detection temperature of a temperature detection means, a control means judges whether a fuel reformer is warming-up operational status or it is in a steady operation condition, and when a fuel reformer is warming-up operational status, the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition. Then, there are few heating values which the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes, and it ends, therefore the heating value for warming up of the evaporation section can be enlarged more, and it becomes possible to shorten the warming-up time amount of a fuel reformer. Moreover, since a superfluous steam does not remain in this reformed gas even if reforming of this water fuel mixed gas will be carried out and reformed gas will generate it at the time of warming-up operational status, if the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition, in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section, dew condensation does not occur during a warm-up.
[0015] In addition, as for the mole ratio (it is hereafter indicated as a S/C ratio) of a steam to the original fuel of said water fuel mixed gas in the warming-up operational status of a fuel reformer, it is desirable that it is the range of 0.7-1.2, and it is [the S/C ratio of the water fuel mixed gas in a steady operation condition] desirable that it is the range of 1.5-2.5.
[0016] Moreover, said adjustment supply means consists of the 1st feed zone (an operation gestalt the 1st fuel injection equipment 12) which supplies a original fuel to said evaporation section, and a original fuel and the 2nd feed zone (an operation gestalt the 2nd fuel injection equipment 13) which supplies the mixed liquor of water to said evaporation section. And said control means stops supply of the original fuel by said 1st feed zone, when said detection temperature is below the temperature that can be operated steadily, said Hara fuel and said mixed liquor are made to supply to said evaporation section from said 1st feed zone and said 2nd feed zone and said detection temperature exceeds the temperature which can be operated steadily.
[0017] With "the temperature which can be operated steadily" here, the steam contained in reformed gas is made into the temperature which does not dew by the derivation path or device of the downstream of the reforming section, and is specifically made into 70 degrees C - 80 degrees C. When it judges that a control means has a fuel reformer in warming-up operational status when said detection temperature is below the temperature that can be operated steadily and the temperature which can be operated steadily is exceeded, it is judged that a fuel reformer is in a steady operation condition.
[0018] The adjustment supply means of this fuel reformer for fuel cells By being controlled by the control means, supplying a original fuel and mixed liquor to the evaporation section, when a fuel reformer is warming-up operational status, and supplying only mixed liquor to the evaporation section,

when a fuel reformer is in a steady operation condition The S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition, and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher than the S/C ratio in warming-up operational status. Thus, the rate of the original fuel supplied to the evaporation section and water can be changed easily, and it becomes possible to adjust the S/C ratio of water fuel mixed gas easily.
[0019] Furthermore, the fuel reformer for fuel cells of this invention branched from the combustion section (an operation gestalt combustion section 2) which generates the combustion gas used as the heat source of said evaporation section, and the middle of said derivation passage, and is equipped with the passage selector valve (an operation gestalt three-way cock 21) arranged at a part for the tee of the bypass path (an operation gestalt bypass piping 37) which supplies said reformed gas to said combustion section, and a this derivation path and a bypass path. And when said detection temperature is below the temperature that can be operated steadily, it is constituted so that said reformed gas may be supplied to said combustion section through said bypass path. According to this fuel reformer, since reformed gas is supplied to the combustion section and it burns at the time of warming-up operational status, it becomes possible to carry out warming up of the combustion section and the evaporation section further. Moreover, since there are few water vapor contents, the heating value generated in case it burns becomes high, and the reformed gas generated at the time of a warm-up becomes possible [carrying out warming up of the combustion section and the evaporation section further].
[0020] The fuel reformer for fuel cells of this invention makes water and a original fuel evaporate, and generates water fuel mixed gas. It is the fuel reformer which reforms this water fuel mixed gas and generates reformed gas. The temperature of the derivation passage to which said reformed gas is supplied, or a device is detected (an operation gestalt step S16). When this detection temperature is the warming-up operational status below steady operation temperature, with (operation gestalt Step S20), The S/C ratio of said water fuel mixed gas is controlled lower than the S/C ratio in the steady operation condition of a fuel reformer (an operation gestalt steps S21 and S22). When detection temperature changes into the steady operation condition beyond steady operation temperature, it is characterized by the thing which control more highly than the S/C ratio in said warming-up operational status the S/C ratio of step S17) and said water fuel mixed gas by (operation gestalt and which was constituted like (an operation gestalt steps S18 and S19).
[0021] There are few heating values which according to this fuel reformer the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes at the time of warming-up operational status since the S/C ratio of water fuel mixed gas is controlled lower than the S/C ratio in a steady operation condition, and it ends, therefore the heating value for warming up of a fuel reformer can be enlarged more, and it becomes possible to shorten the warming-up time amount of a fuel reformer. Moreover, since the S/C ratio of water fuel mixed gas is controlled lower than the S/C ratio in a steady operation condition, even if reforming of this water fuel mixed gas is carried out and reformed gas generates it at the time of warming-up operational status, a superfluous steam does not remain in this reformed gas, and dew condensation is not generated in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section.
[0022] The fuel reformer for fuel cells of this invention is faced generating said water fuel mixed gas. Moreover, in said warming-up operational status While supplying a original fuel to the evaporation section which generates this water fuel mixed gas, the mixed liquor of a original fuel and water is supplied (an operation gestalt steps S21 and S22). In the state of said steady operation Supply of the original fuel at the time of said warm-up is suspended, and it is characterized by ** which supplies said mixed liquor and which was constituted like (an operation gestalt steps S18 and S19).
[0023] Since only mixed liquor is supplied to the evaporation section when according to this fuel reformer a original fuel and mixed liquor are supplied to the evaporation section and it changes into a steady operation condition at the time of warming-up operational status The S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition, and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher

than the S/C ratio in warming-up operational status. Thus, the rate of the original fuel supplied to the evaporation section and water can be changed easily, and it becomes possible to adjust the S/C ratio of water fuel mixed gas easily.
[0024]
[Embodiment of the Invention] Hereafter, the fuel reformer for fuel cells which is the operation gestalt of this invention is explained with reference to a drawing. The block diagram of the fuel reformer 1 for fuel cells of this invention is shown in drawing 1 . This fuel reformer 1 is constituted considering the combustion section 2 which generates combustion gas, the evaporation section 3 which evaporates the mixed liquor of a original fuel and water with the heat of said combustion gas, and generates water fuel mixed gas, the reforming section 4 which generates the reformed gas which reforms said water fuel mixed gas and contains hydrogen, CO removal section 6 which carry out oxidation removal of the carbon monoxide which sub**(ed) in said reformed gas, and the starting combustion section 8 as a subject.
[0025] While the combustion section 2 is equipped with the catalyst for combustion which is not illustrated, the fuel tank 9 for combustion is attached. The combustion gas which the fuel for combustion supplied to the combustion section 2 from the fuel tank 9 for combustion burns on the catalyst for combustion, and generates at this time is supplied to the evaporation section 3.
[0026] The 1st fuel injection equipment 12 which is the 1st feed zone, and the 2nd fuel injection equipment 13 which is the 2nd feed zone are attached, a fuel tank 10 is attached in the 1st fuel injection equipment 12 through piping 39, and the mixed liquor tank 11 is attached in the 2nd fuel injection equipment 13 through piping 40 at the evaporation section 3. The adjustment supply means is constituted by these 1st fuel injection equipments 12 (the 1st feed zone) and the 2nd fuel injection equipment 13 (the 2nd feed zone). This adjustment supply means adjusts the mole ratio (it is hereafter indicated as a S/C ratio) of water to the original fuel in water fuel mixed gas while supplying a original fuel and water to the evaporation section 3. A fuel tank 10 is filled up with a original fuel, and the mixed liquor tank 11 is filled up with the mixed liquor of a original fuel and water. As a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, etc. can be mentioned, for example.
[0027] The reforming section 4 is equipped with the reforming catalyst, if it is heated by 200 degrees C or more and water fuel mixed gas is supplied to this reforming section 4 with the oxygen in air, the reaction shown in following reaction-formulae (1) - (3) on a reforming catalyst will advance, and reformed gas will generate this reforming catalyst. In addition, this reaction-formula (1) - (3) shows the reaction at the time of using a methanol as a original fuel.
[0028]
$CH_3OH + H_2O \rightarrow 3H_2 + CO_2$ -- (1)
$CH_3OH + 2O_2 \rightarrow 2H_2O + CO_2$ -- (2)
$CH_3OH \rightarrow 2H_2 + CO$ -- (3)
[0029] A reaction formula (1) is a reforming reaction by the methanol and water which are a original fuel, hydrogen (H_2) generates it, a reaction formula (2) is oxidation reaction of a methanol, water (H_2O) generates it, a reaction formula (3) is the decomposition reaction of a methanol, and the carbon monoxide (CO) of a minute amount generates it. It is endothermic reaction, supply of the heat from the outside is needed, and a reforming reaction (reaction formula (1)) compensates this by the heat of combustion generated by oxidation (reaction formula (2)) of a methanol. Thus, the reformed gas containing hydrogen (fuel), a steam(water), and a carbon monoxide generates.
[0030] At the time of steady operation, this fuel reformer 1 by setting the mole ratio (it being hereafter indicated as a S/C ratio) of the original fuel and water of water fuel mixed gas as the range of 1.5-2.5 Theoretical reaction molar quantity of water [in / for the water vapor content in water fuel mixed gas / a reforming reaction] (by the mole ratio) Original fuel (methanol): Water can be supplied now to the polyelectrolyte film of a fuel cell 51 by making the steam for this excess remain in reformed gas after a reforming reaction, and supplying the reformed gas containing the steam for this excess to a fuel cell 51 as more superfluous than water =1:1.

[0031] While having the catalyst for combustion which is not illustrated, the feeder which supplies the fuel for starting combustion and air and which is not illustrated is attached in the starting combustion section 8. Moreover, a heat exchanger 5 is attached in between the reforming section 4 and CO removal sections 6 (i.e., the downstream of the reforming section 4) through piping 34, and the heat exchanger 7 is attached in the downstream of CO removal section 6 through piping 36 at it. Furthermore, the fuel cell 51 of a solid-state macromolecule mold is connected to the downstream of a heat exchanger 7 through the derivation piping 41.

[0032] A heat exchanger 5 cools the reformed gas supplied from the reforming section 4. It is because the reformed gas to which the reason for having formed the heat exchanger 5 came out of the reforming section 4 is heated by 200 degrees C or more, the operating temperature of latter CO removal section 6 is about 100-150 degrees C, so it is necessary to cool reformed gas at about 100 degrees C. CO removal section 6 is equipped with the selective oxidation catalyst which is not illustrated, and this selective oxidation catalyst is heated by about 100 degrees C, and when the carbon monoxide in reformed gas oxidizes according to this selective oxidation catalyst and a carbon dioxide generates, the carbon monoxide in reformed gas is removed. A heat exchanger 7 cools the reformed gas supplied from CO removal section 6. The reason for having formed the heat exchanger 7 is that it is heated by 150-200 degrees C when reformed gas comes out of CO removal section 6, and it is necessary to cool reformed gas at about 80 degrees C since the operating temperature of the latter fuel cell 51 is about 80-130 degrees C.

[0033] The reformed gas which passed the heat exchanger 7 is supplied to a fuel cell 51 through the derivation piping 41, the hydrogen in reformed gas (fuel) and the oxygen supplied separately cause electrochemical reaction, and a generation of electrical energy is performed. Moreover, the piping 42 from the fuel cell 51 to the combustion section 2 is formed, the exhaust gas containing the unconverted gas discharged from the fuel cell 51 is supplied to the combustion section 2, and a unconverted gas can be burned now in the combustion section 2.

[0034] Moreover, the 3rd thermometer 24 whose 2nd thermometer 23 the 1st thermometer 22 is a temperature detection means in the reforming section 4 at the derivation piping 41 is attached at the evaporation section 3, respectively, and these the 1st, 2, and 3 thermometers 22, 23, and 24 are connected to the control section 25. Moreover, the 1st and 2 fuel injection equipments 12 and 13 which are the 1st and 2 feed zones are connected to the control section 25. This control section 25 controls the 1st and 2 fuel injection equipments 12 and 13 which are adjustment supply means based on the detection temperature of the 3rd thermometer 24, and when detection temperature is below the temperature that can be operated steadily, a original fuel and mixed liquor are made to supply to the evaporation section 3 from the 1st and 2 fuel injection equipments 12 and 13 and detection temperature exceeds the temperature which can be operated steadily, it stops supply of the original fuel by the 1st fuel injection equipment 12. With the temperature which can be operated steadily, the steam contained in reformed gas is made into the temperature which does not dew at the derivation path 41 of the downstream of the reforming section 4, and is specifically made into 70 degrees C - 80 degrees C here.

[0035] Moreover, the BAIBASU tubing 37 is branched and attached in the derivation piping 41. This by-path pipe 37 is connected to the combustion section 2. And the Mikata bulb 21 is attached in a part for the tee of piping 41 and the bypass piping 37. This Mikata bulb 21 is connected to the control section 25.

[0036] Next, in order to explain actuation of the control section 25 of the fuel reformer 1 for fuel cells, with reference to drawing 1 and drawing 2 , actuation until it results [from starting of the fuel reformer 1] in a steady operation condition is explained. First, in step S1, the memory in a control section 25 is set to an initial value, and the derivation piping 41 and the bypass piping 37 are connected by the Mikata bulb 21. Next, in step S2, each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24 and T3 are read.

[0037] Next, in step S3, it judges whether the detection temperature T2 of the 2nd thermometer 23 which detects the temperature of the reforming section 4 exceeded the reforming initiation temperature Ty in the reforming initiation temperature judging section in a control section 25. Reforming initiation

temperature Ty is made into the activation temperature to which a reforming reaction advances in a reforming catalyst, and is set up in 180-250 degrees C. When the detection temperature T2 exceeds the reforming initiation temperature Ty, "1" is inputted into the reforming initiation temperature judging flag F2 in step S4, and when the detection temperature T2 is below the reforming initiation temperature Ty, "0" is inputted into the reforming initiation temperature judging flag F2 in step S6.
[0038] When the reforming initiation temperature judging flag F2 is "0", in step S7, the fuel for starting and air are supplied to the starting combustion section 8, the fuel for starting burns, the starting combustion gas which occurred is sent to the reforming section 4 and its downstream through piping 38, and warming up of the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is carried out.
[0039] Next, in step S8, it judges whether the detection temperature T1 of the 1st thermometer 22 which detects the temperature of the evaporation section 3 exceeded the evaporation initiation temperature Tx in the evaporation initiation temperature judging section in a control section 25. Evaporation initiation temperature Tx is made into temperature with possible making water and a original fuel evaporate in an instant, and is set up in 150-250 degrees C. When the detection temperature T1 exceeds the evaporation initiation temperature Tx, "1" is inputted into the evaporation initiation temperature judging flag F1 in step S9, and when the detection temperature T1 is below the evaporation initiation temperature Ty, "0" is inputted into the evaporation initiation temperature judging flag F1 in step S11.
[0040] When the evaporation initiation temperature judging flag F1 is "0", in step S12, the fuel for combustion burns in the combustion section 2, combustion gas occurs, this combustion gas is sent to the evaporation section 3 and its downstream through piping 32, and warming up of the evaporation section 3, the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is carried out.
[0041] Next, in step S13, it judges whether detection temperature T3 of the 3rd thermometer 24 which detects the temperature of the derivation piping 41 exceeded the steady operation initiation temperature Tz in the steady operation initiation temperature judging section in a control section 25. Temperature Tz which can be operated steadily is made into the temperature which the steam contained in reformed gas does not dew at the derivation path 41, and is specifically made into 70 degrees C - 80 degrees C. When detection temperature T3 exceeds the steady operation initiation temperature Tz, "1" is inputted into the steady operation initiation temperature judging flag F3 in step S14, and when detection temperature T3 is below the steady operation initiation temperature Tz, "0" is inputted into the steady operation initiation temperature judging flag F3 in step S15.
[0042] Next, in step S16, each input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 is judged in the steady operation judging section of a control section 25. When any one input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 is "0", it judges that the fuel reformer 1 is warming-up operational status (when it is F1*F2*F3=0), and progresses to step S20.
[0043] In step S20, warming-up operation mode is chosen and a warm-up is continued. An actuating signal is specifically sent to the 1st and 2 fuel injection equipments 12 and 13 from a control section 25. In the step S22 both, mixed liquor is supplied from the 2nd fuel injection equipment 13. in step S21, a original fuel is supplied to the evaporation section 3 from the 1st fuel injection equipment 12 -- Water fuel mixed gas generates and warming up of the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is continued. Moreover, water fuel mixed gas is sent to the combustion section 2 from the bypass piping 37 through a three-way cock 21, the hydrogen in water fuel mixed gas burns, and warming up of the combustion section 2 is carried out.
[0044] Let the S/C ratio of the water fuel mixed gas generated at this time be the range of 0.7-1.2. And air (oxygen) is sent from the starting combustion section 8, while this water fuel mixed gas is sent to the reforming section 4, in the reforming section 4, the reaction shown in above-mentioned reaction-formula (1) - (3) on the reforming catalyst advances, and the reformed gas containing hydrogen generates in it.
[0045] For the reformed gas generated at this time, the molar quantity of the steam with which the S/C

ratio of water fuel mixed gas is made into the range of 0.7-1.2, and is supplied to the reforming section 4 is the theoretical reaction molar quantity (it is a mole ratio) of the water in a reforming reaction. Original fuel (methanol) : Since it becomes almost equal to water =1:1, a steam does not remain in reformed gas after a reforming reaction. Even if the temperature of the heat exchangers 5 and 7 in the downstream of the reforming section, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is low, dew condensation of a steam does not occur inside these piping or a device.

[0046] Thus, a warm-up is continued and each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24 and T3 go up gradually.

[0047] Next, return, each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24, and T3 are again read into step S2. Next, in step S3, it judges again whether the detection temperature T2 of the 2nd thermometer 23 exceeded the reforming initiation temperature Ty in the reforming initiation temperature judging section in a control section 25.

[0048] If the reforming initiation temperature judging flag F2 is set to "1" for the detection temperature T2 of the 2nd thermometer 23 exceeding the reforming initiation temperature Ty (step S4), in step S5, supply of the fuel for starting to the starting combustion section 8 will be suspended. Thereby, although combustion of the starting combustion section 8 stops, only air is supplied and this air is sent to the reforming section 4 through piping 38.

[0049] Next, in step S8, it judges again whether the detection temperature T1 of the 1st thermometer 22 exceeded the evaporation initiation temperature Tx in the evaporation initiation temperature judging section in a control section 25. If the evaporation initiation temperature judging flag F1 is set to "1" for the detection temperature T1 of the 1st thermometer 22 exceeding the evaporation initiation temperature Tx (step S9), in step S10, supply of the fuel for combustion to the combustion section 2 will be suspended.

[0050] Next, in step S13, it judges again whether detection temperature T3 of the 3rd thermometer 24 exceeded the steady operation initiation temperature Tz in the steady operation initiation temperature judging section in a control section 25. If detection temperature T3 of the 3rd thermometer 24 exceeds the steady operation initiation temperature Tz, the steady operation initiation temperature judging flag F3 will be set to "1" (step S14), and it will progress to step S16.

[0051] In step S16, each input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 is again judged in the steady operation judging section of a control section 25. When all the input values of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 are "1", it is judged that the fuel reformer 1 resulted [from warming-up operational status] in the steady operation condition (when it is F1*F2*F3=1), and it progresses to step S17.

[0052] In step S17, steady operation mode is chosen and steady operation is started. While a stop signal is sent to the 1st fuel injection equipment 12 from a control section 25 and supply in the evaporation section 3 of the original fuel from the 1st fuel injection equipment 12 makes it specifically stop (step S18), supply of the mixed liquor from the 2nd fuel injection equipment 13 is made to continue (step S19), and **** fuel mixed gas is made to generate. Moreover, the Mikata bulb 21 is changed and the derivation piping 41 is connected with a fuel cell 51. Let the S/C ratio of the water fuel mixed gas generated at this time be the range of 1.5-2.5. And air (oxygen) is sent from the starting combustion section 8, while this water fuel mixed gas is sent to the reforming section 4, in the reforming section 4, the reaction shown in above-mentioned reaction-formula (1) - (3) on the reforming catalyst advances, and the reformed gas containing hydrogen generates in it. It becomes more superfluous [the reformed gas generated at this time] than the theoretical reaction molar quantity (original fuel (methanol): being a mole ratio water = 1:1) of water [in / in the molar quantity of the steam supplied to the reforming section 4 / a reforming reaction], since the S/C ratio of water fuel mixed gas is made into the range of 1.5-2.5, and the steam for this excess will remain in reformed gas after a reforming reaction. The reformed gas containing the steam for this excess is supplied to a fuel cell 51 through CO removal section 6 and the Mikata bulb 21, and water is supplied to the polyelectrolyte film of a fuel cell 51.

[0053] In addition, if the S/C ratio of the water fuel mixed gas at this time (steady operation condition) is 1.5 or less Since a water vapor content falls, the water vapor content which remains in reformed gas decreases and it becomes impossible to supply sufficient water for the polyelectrolyte film of a fuel cell 51, if a S/C ratio exceeds 2.5 preferably Since a water vapor content increases, the steam beyond the need remains in reformed gas and water piles up in piping, device, or fuel cell 51 of the downstream of the reforming section 4, it is not desirable.
[0054] Moreover, since the temperature of the derivation piping 41 is rising to the temperature (temperature which can be operated steadily) which a steam does not already dew, a steam does not dew inside the derivation piping 41. Moreover, if the temperature of the derivation piping 41 is rising to the temperature which can be operated steadily, since the heat exchangers 5 and 7 in the upstream, CO removal section 6, and the temperature of piping 34, 35, and 36 are rising to temperature higher naturally than the derivation piping 41, a steam will not dew inside these piping or a device.
[0055]
[Effect of the Invention] As explained above, the fuel reformer for fuel cells of this invention An adjustment supply means to adjust the S/C ratio of water fuel mixed gas while supplying a original fuel and water to the evaporation section, It is based on the detection temperature of a temperature detection means to detect the temperature of derivation passage or a device, and this temperature detection means. It has the control means which controls said adjustment supply means. A control means Judge whether a fuel reformer is warming-up operational status or it is in a steady operation condition, and when a fuel reformer is warming-up operational status Since the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition There are few heating values which the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes, and it ends, therefore the heating value for warming up of the evaporation section can be enlarged more, and the warming-up time amount of a fuel reformer can be shortened. Moreover, since a superfluous steam does not remain in this reformed gas even if reforming of this water fuel mixed gas will be carried out and reformed gas will generate it at the time of warming-up operational status, if the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition, in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section, generating of dew condensation can be prevented during a warm-up.
[0056] Moreover, the adjustment supply means of this fuel reformer for fuel cells By being controlled by the control means, supplying a original fuel and mixed liquor to the evaporation section, when a fuel reformer is warming-up operational status, and supplying only mixed liquor to the evaporation section, when a fuel reformer is usual state operational status Since the S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher than the S/C ratio in warming-up operational status The rate of the original fuel supplied to the evaporation section and water can be changed easily, and the S/C ratio of water fuel mixed gas can be adjusted easily.
[0057] Furthermore, the fuel reformer for fuel cells of this invention branches from the middle of said derivation passage. Since it has the bypass path which supplies said reformed gas to said combustion section, and it is constituted so that said reformed gas may be supplied to said combustion section through said bypass path when said detection temperature is below the temperature that can be operated steadily At the time of warming-up operational status, reformed gas can be supplied to the combustion section, it can burn, it becomes possible to carry out warming up of the combustion section and the evaporation section further, and warming-up operation time can be shortened more. Moreover, since there are few water vapor contents, the heating value generated in case it burns becomes high, and the reformed gas generated at the time of a warm-up becomes possible [carrying out warming up of the combustion section and the evaporation section further].
[0058] The fuel reformer for fuel cells of this invention detects the temperature of the derivation passage to which reformed gas is supplied, or a device. Since the S/C ratio of said water fuel mixed gas is made lower than the S/C ratio in a steady operation condition when this detection temperature is the warming-up operational status below steady operation temperature There can be few heating values which the

amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes, and it can end, therefore the heating value for warming up of a fuel reformer can be enlarged more, and the warming-up time amount of a fuel reformer can be shortened. Moreover, even if reforming of this water fuel mixed gas is carried out and reformed gas generates, a superfluous steam does not remain in this reformed gas, and generating of dew condensation can be prevented in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section.

[0059] Furthermore, since the S/C ratio of said water fuel mixed gas is controlled more highly than the S/C ratio in said warming-up operational status when detection temperature changes into the steady operation condition beyond steady operation temperature, a superfluous steam can be made to remain in reformed gas.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the fuel reformer for fuel cells which can short-**** warming-up time amount especially about the fuel reformer for fuel cells.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The fuel cell of a solid-state macromolecule mold comes to provide the stack cel which comes to insert the polyelectrolyte film with an anode and a cathode, supplies oxygen to an anode at the hydrogen and the cathode which are a fuel, respectively, causes electrochemical reaction, and generates it. Since the hydrogen ion generated with the anode passes the polyelectrolyte film and moves to a cathode, in order to maintain the ion conductivity of the polyelectrolyte film, it needs to supply water to the polyelectrolyte film.
[0003] By the way, as a hydrogen source of supply of a fuel cell, the fuel reformer is used from the former. This fuel reformer generates the reformed gas containing hydrogen (fuel) by evaporating a original fuel and water, such as a hydrocarbon system compound or an alcoholic system compound, forming water fuel mixed gas, and reforming this using a reforming catalyst. And this fuel reformer includes a superfluous steam in reformed gas, in order to supply water to the polyelectrolyte film of a fuel cell.
[0004] This conventional fuel reformer for fuel cells is explained with reference to a drawing. The block diagram of the conventional fuel reformer 101 is shown in drawing 3 . The combustion section 102 which this fuel reformer 101 makes generate combustion gas, The evaporation section 103 which evaporates the mixed liquor of a original fuel and water with the heat of said combustion gas, and generates water fuel mixed gas, The reforming section 104 which generates the reformed gas which is equipped with a reforming catalyst, reforms said water fuel mixed gas according to this reforming catalyst, and contains hydrogen, It has a selective oxidation catalyst and the carbon monoxide removal section 105 (it is hereafter indicated as CO removal section) which carries out oxidation removal of the carbon monoxide which sub**(ed) in said reformed gas according to this selective oxidation catalyst, and the starting combustion section 106 are constituted as a subject.
[0005] While having a catalyst for combustion, the fuel tank 107 for combustion is attached in the combustion section 102. Moreover, a fuel injection equipment 109 is attached in the evaporation section 103, and the mixed liquor tank 108 is attached in this fuel injection equipment 109 through piping 110 at it. The mixed liquor tank 108 is filled up with the mixed liquor of a original fuel and water. As a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, are used, for example. Moreover, while having a catalyst for combustion, the feeder which supplies the fuel for starting combustion and air and which is not illustrated is attached in the starting combustion section 106. Moreover, the fuel cell 51 of a solid-state macromolecule mold is connected to CO removal section 105 through piping 111.
[0006] Next, actuation until it puts the fuel reformer 101 for fuel cells into operation and results in a steady operation condition is explained. First, warming up of delivery, the reforming section 104, and the CO removal section 105 is carried out for the starting combustion gas which burned and generated the fuel for starting in the starting combustion section 106 to the reforming section 104 through piping 112. Warming up of delivery and the evaporation section 103 is carried out for the combustion gas which burned and generated the fuel for combustion in the combustion section 102 to coincidence through piping 113 at the evaporation section 103.

[0007] And while the temperature of the reforming catalyst of the reforming section 104 amounts to about 200 degrees C, when the temperature of the evaporation section 103 reaches the temperature (about 200 degrees C) which may make water fuel mixed gas evaporate While suspending supply of the prime fuel to the starting combustion section 106, mixed liquor is supplied to a fuel injection equipment 109 from the mixed liquor tank 108, mixed liquor is injected in the evaporation section 103, with the heat of the combustion gas supplied from the combustion section 102, mixed liquor is evaporated and water fuel mixed gas is generated.
[0008] And this water fuel mixed gas is sent to the reforming section 104 through piping 114. In the reforming section 104, air is supplied from the starting combustion section 106 at the same time water fuel mixed gas is sent, and the reformed gas which reforming of the original fuel is carried out under existence of a steam and oxygen by the reforming catalyst with which the reforming section 104 was equipped, and contains hydrogen according to it generates. Reformed gas is sent to CO removal section 105 through piping 113, and carries out oxidation removal of the carbon monoxide which sub**(ed) in reformed gas in CO removal section 105 with a selective oxidation catalyst. And reformed gas is supplied to a fuel cell 51 through piping 111.
[0009] In this fuel reformer 101, the mole ratio (it is hereafter indicated as a S/C ratio) of water to the original fuel of water fuel mixed gas is set as the range of 1.5-2.5. Theoretical reaction molar quantity of water [in / for the molar quantity of the steam in water fuel mixed gas / a reforming reaction] (by the mole ratio) Original fuel (methanol) : by making the steam for this excess remain in reformed gas after a reforming reaction, and supplying the reformed gas containing the steam for this excess to a fuel cell 51 by supposing that it is more superfluous than water =1:1 Water can be supplied now to the polyelectrolyte film of a fuel cell 51.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, while the fuel reformer for fuel cells of this invention supplies a original fuel and water to the evaporation section, it has an adjustment supply means to adjust the S/C ratio of water fuel mixed gas, a temperature detection means to detect the temperature of derivation passage or a device, and the control means that controls said adjustment supply means based on the detection temperature of this temperature detection means. A control means judges whether a fuel reformer is warming-up operational status or it is in a steady operation condition, and when a fuel reformer is warming-up operational status Since the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition There are few heating values which the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes, and it ends, therefore the heating value for warming up of the evaporation section can be enlarged more, and the warming-up time amount of a fuel reformer can be shortened. Moreover, since a superfluous steam does not remain in this reformed gas even if reforming of this water fuel mixed gas will be carried out and reformed gas will generate it at the time of warming-up operational status, if the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition, in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section, generating of dew condensation can be prevented during a warm-up.
[0056] Moreover, the adjustment supply means of this fuel reformer for fuel cells, By being controlled by the control means, supplying a original fuel and mixed liquor to the evaporation section, when a fuel reformer is warming-up operational status, and supplying only mixed liquor to the evaporation section, when a fuel reformer is usual state operational status Since the S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher than the S/C ratio in warming-up operational status The rate of the original fuel supplied to the evaporation section and water can be changed easily, and the S/C ratio of water fuel mixed gas can be adjusted easily.
[0057] Furthermore, the fuel reformer for fuel cells of this invention branches from the middle of said derivation passage, Since it has the bypass path which supplies said reformed gas to said combustion section, and it is constituted so that said reformed gas may be supplied to said combustion section through said bypass path when said detection temperature is below the temperature that can be operated steadily, at the time of warming-up operational status, reformed gas can be supplied to the combustion section, it can burn, it becomes possible to carry out warming up of the combustion section and the evaporation section further, and warming-up operation time can be shortened more. Moreover, since there are few water vapor contents, the heating value generated in case it burns becomes high, and the reformed gas generated at the time of a warm-up becomes possible [carrying out warming up of the combustion section and the evaporation section further].
[0058] the heating value which the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes since the fuel reformer for fuel cells of this invention detects the temperature of the derivation passage to which reformed gas is supplied, or a device, and the S/C ratio of said water fuel mixed gas is made lower than the S/C ratio in a steady operation condition

when this detection temperature is the warming-up operational status below steady operation temperature -- being few -- ending -- therefore The heating value for warming up of a fuel reformer can be enlarged more, and the warming-up time amount of a fuel reformer can be shortened. Moreover, even if reforming of this water fuel mixed gas is carried out and reformed gas generates, a superfluous steam does not remain in this reformed gas, and generating of dew condensation can be prevented in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section.
[0059] Furthermore, since the S/C ratio of said water fuel mixed gas is controlled more highly than the S/C ratio in said warming-up operational status when detection temperature changes into the steady operation condition beyond steady operation temperature, a superfluous steam can be made to remain in reformed gas.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it sets to the conventional fuel reformer 101 for fuel cells. Since it is higher than the heat of vaporization of the methanol whose heat of vaporization of water the amount of the water injected in the evaporation section 103 increases in order to make high the S/C ratio of water fuel mixed gas, and is a original fuel, In order to generate water fuel mixed gas, many heating values were needed, the heating value for carrying out warming up of the evaporation section 103 by this decreased, and the technical problem that warming up of the fuel reformer 101 took long duration occurred.
[0011] Moreover, in the conventional fuel reformer 101 for fuel cells, although the starting combustion section 106 performs warming up of the reforming section 104 and CO removal section 105 Since CO removal section 105 is formed in the downstream rather than the reforming section 104, When warming up of the reforming section 104 is carried out and the fuel reformer 101 reaches operational status, warming up of the piping 111 in CO removal section 105 and its downstream may not fully be carried out, for example, such temperature may be 80 degrees C or less. When the reformed gas which contains a steam in this condition passed CO removal section 105 and piping 111, the steam dewed for CO removal section 105 and piping 111, water piled up, and the technical problem that the catalyst ability of a selective oxidation catalyst falls with this water, the removal effectiveness of a carbon monoxide will fall or the passage of reformed gas will be blockaded occurred.
[0012] This invention is made in order to solve the above-mentioned technical problem, and warming-up operation time is short and it aims at offering the fuel reformer for fuel cells which the steam in reformed gas does not dew within equipment in warming-up operational status.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention adopted the following configurations. The fuel reformer for fuel cells of this invention comes to provide the evaporation section (an operation gestalt evaporation section 3) which is made to evaporate the original fuel containing water and a hydrocarbon, and generates water fuel mixed gas, and the reforming section (an operation gestalt reforming section 4) which generates the reformed gas which reforms said water fuel mixed gas and contains hydrogen. Moreover, an adjustment supply means to adjust the mole ratio (for it to be hereafter indicated as a S/C ratio) of water to the original fuel in said water fuel mixed gas while this fuel reformer supplies said Hara fuel and said water to said evaporation section (an operation gestalt the 1st and 2nd fuel injection equipment 12 and 13), A temperature detection means for it to be prepared in the derivation passage (the operation gestalt derivation piping 41) or the device of the downstream of said reforming section, and to detect the temperature of this derivation passage or a device (an operation gestalt the 3rd thermometer 24), Based on the detection temperature of this temperature detection means, it comes to have the control means (an operation gestalt control section 25) which controls said adjustment supply means. Here, "the device of the downstream of said reforming section" means the heat exchanger prepared in the downstream of the reforming section, the carbon monoxide removal section (it is hereafter indicated as CO removal section), an auxiliary burner, and the other devices prepared if needed. Furthermore, as a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, etc. can be mentioned, for example.
[0014] According to this fuel reformer, based on the detection temperature of a temperature detection means, a control means judges whether a fuel reformer is warming-up operational status or it is in a steady operation condition, and when a fuel reformer is warming-up operational status, the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition. Then, there are few heating values which the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes, and it ends, therefore the heating value for warming up of the evaporation section can be enlarged more, and it becomes possible to shorten the warming-up time amount of a fuel reformer. Moreover, since a superfluous steam does not remain in this reformed gas even if reforming of this water fuel mixed gas will be carried out and reformed gas will generate it at the time of warming-up operational status, if the S/C ratio of water fuel mixed gas is made lower than the S/C ratio in a steady operation condition, in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section, dew condensation does not occur during a warm-up.
[0015] In addition, as for the mole ratio (it is hereafter indicated as a S/C ratio) of a steam to the original fuel of said water fuel mixed gas in the warming-up operational status of a fuel reformer, it is desirable that it is the range of 0.7-1.2, and it is [the S/C ratio of the water fuel mixed gas in a steady operation condition] desirable that it is the range of 1.5-2.5.
[0016] Moreover, said adjustment supply means consists of the 1st feed zone (an operation gestalt the 1st fuel injection equipment 12) which supplies a original fuel to said evaporation section, and a original

fuel and the 2nd feed zone (an operation gestalt the 2nd fuel injection equipment 13) which supplies the mixed liquor of water to said evaporation section. And said control means stops supply of the original fuel by said 1st feed zone, when said detection temperature is below the temperature that can be operated steadily, said Hara fuel and said mixed liquor are made to supply to said evaporation section from said 1st feed zone and said 2nd feed zone and said detection temperature exceeds the temperature which can be operated steadily.

[0017] With "the temperature which can be operated steadily" here, the steam contained in reformed gas is made into the temperature which does not dew by the derivation path or device of the downstream of the reforming section, and is specifically made into 70 degrees C - 80 degrees C. When it judges that a control means has a fuel reformer in warming-up operational status when said detection temperature is below the temperature that can be operated steadily and the temperature which can be operated steadily is exceeded, it is judged that a fuel reformer is in a steady operation condition.

[0018] The adjustment supply means of this fuel reformer for fuel cells By being controlled by the control means, supplying a original fuel and mixed liquor to the evaporation section, when a fuel reformer is warming-up operational status, and supplying only mixed liquor to the evaporation section, when a fuel reformer is in a steady operation condition The S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition, and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher than the S/C ratio in warming-up operational status. Thus, the rate of the original fuel supplied to the evaporation section and water can be changed easily, and it becomes possible to adjust the S/C ratio of water fuel mixed gas easily.

[0019] Furthermore, the fuel reformer for fuel cells of this invention branched from the combustion section (an operation gestalt combustion section 2) which generates the combustion gas used as the heat source of said evaporation section, and the middle of said derivation passage, and is equipped with the passage selector valve (an operation gestalt three-way cock 21) arranged at a part for the tee of the bypass path (an operation gestalt bypass piping 37) which supplies said reformed gas to said combustion section, and a this derivation path and a bypass path. And when said detection temperature is below the temperature that can be operated steadily, it is constituted so that said reformed gas may be supplied to said combustion section through said bypass path. According to this fuel reformer, since reformed gas is supplied to the combustion section and it burns at the time of warming-up operational status, it becomes possible to carry out warming up of the combustion section and the evaporation section further. Moreover, since there are few water vapor contents, the heating value generated in case it burns becomes high, and the reformed gas generated at the time of a warm-up becomes possible [carrying out warming up of the combustion section and the evaporation section further].

[0020] The fuel reformer for fuel cells of this invention makes water and a original fuel evaporate, and generates water fuel mixed gas. It is the fuel reformer which reforms this water fuel mixed gas and generates reformed gas. The temperature of the derivation passage to which said reformed gas is supplied, or a device is detected (an operation gestalt step S16). When this detection temperature is the warming-up operational status below steady operation temperature, with (operation gestalt Step S20), The S/C ratio of said water fuel mixed gas is controlled lower than the S/C ratio in the steady operation condition of a fuel reformer (an operation gestalt steps S21 and S22). When detection temperature changes into the steady operation condition beyond steady operation temperature, it is characterized by the thing which control more highly than the S/C ratio in said warming-up operational status the S/C ratio of step S17) and said water fuel mixed gas by (operation gestalt and which was constituted like (an operation gestalt steps S18 and S19).

[0021] There are few heating values which according to this fuel reformer the amount of supply of the water to the evaporation section decreases, and generation of water fuel mixed gas takes at the time of warming-up operational status since the S/C ratio of water fuel mixed gas is controlled lower than the S/C ratio in a steady operation condition, and it ends, therefore the heating value for warming up of a fuel reformer can be enlarged more, and it becomes possible to shorten the warming-up time amount of a fuel reformer. Moreover, since the S/C ratio of water fuel mixed gas is controlled lower than the S/C

ratio in a steady operation condition, even if reforming of this water fuel mixed gas is carried out and reformed gas generates it at the time of warming-up operational status, a superfluous steam does not remain in this reformed gas, and dew condensation is not generated in the derivation passage or the device of the downstream of the interior of a fuel reformer, especially the reforming section.

[0022] The fuel reformer for fuel cells of this invention is faced generating said water fuel mixed gas. Moreover, in said warming-up operational status While supplying a original fuel to the evaporation section which generates this water fuel mixed gas, the mixed liquor of a original fuel and water is supplied (an operation gestalt steps S21 and S22). In the state of said steady operation Supply of the original fuel at the time of said warm-up is suspended, and it is characterized by ** which supplies said mixed liquor and which was constituted like (an operation gestalt steps S18 and S19).

[0023] Since only mixed liquor is supplied to the evaporation section when according to this fuel reformer a original fuel and mixed liquor are supplied to the evaporation section and it changes into a steady operation condition at the time of warming-up operational status The S/C ratio of the water fuel mixed gas in warming-up operational status is made lower than the S/C ratio in a steady operation condition, and the S/C ratio of the water fuel mixed gas in a steady operation condition is made higher than the S/C ratio in warming-up operational status. Thus, the rate of the original fuel supplied to the evaporation section and water can be changed easily, and it becomes possible to adjust the S/C ratio of water fuel mixed gas easily.

[0024]

[Embodiment of the Invention] Hereafter, the fuel reformer for fuel cells which is the operation gestalt of this invention is explained with reference to a drawing. The block diagram of the fuel reformer 1 for fuel cells of this invention is shown in drawing 1 . This fuel reformer 1 is constituted considering the combustion section 2 which generates combustion gas, the evaporation section 3 which evaporates the mixed liquor of a original fuel and water with the heat of said combustion gas, and generates water fuel mixed gas, the reforming section 4 which generates the reformed gas which reforms said water fuel mixed gas and contains hydrogen, CO removal section 6 which carry out oxidation removal of the carbon monoxide which sub**(ed) in said reformed gas, and the starting combustion section 8 as a subject.

[0025] While the combustion section 2 is equipped with the catalyst for combustion which is not illustrated, the fuel tank 9 for combustion is attached. The combustion gas which the fuel for combustion supplied to the combustion section 2 from the fuel tank 9 for combustion burns on the catalyst for combustion, and generates at this time is supplied to the evaporation section 3.

[0026] The 1st fuel injection equipment 12 which is the 1st feed zone, and the 2nd fuel injection equipment 13 which is the 2nd feed zone are attached, a fuel tank 10 is attached in the 1st fuel injection equipment 12 through piping 39, and the mixed liquor tank 11 is attached in the 2nd fuel injection equipment 13 through piping 40 at the evaporation section 3. The adjustment supply means is constituted by these 1st fuel injection equipments 12 (the 1st feed zone) and the 2nd fuel injection equipment 13 (the 2nd feed zone). This adjustment supply means adjusts the mole ratio (it is hereafter indicated as a S/C ratio) of water to the original fuel in water fuel mixed gas while supplying a original fuel and water to the evaporation section 3. A fuel tank 10 is filled up with a original fuel, and the mixed liquor tank 11 is filled up with the mixed liquor of a original fuel and water. As a original fuel, hydrocarbon system compounds, such as alcoholic system compounds, such as a methanol, methane, ethane, and a gasoline, etc. can be mentioned, for example.

[0027] The reforming section 4 is equipped with the reforming catalyst, if it is heated by 200 degrees C or more and water fuel mixed gas is supplied to this reforming section 4 with the oxygen in air, the reaction shown in following reaction-formulae (1) - (3) on a reforming catalyst will advance, and reformed gas will generate this reforming catalyst. In addition, this reaction-formula (1) - (3) shows the reaction at the time of using a methanol as a original fuel.

[0028]

$CH_3OH + H_2O \rightarrow 3H_2 + CO_2$ -- (1)

$CH_3OH + 2O_2 \rightarrow 2H_2O + CO_2$ -- (2)

h g cg b eb cg e e

$CH3OH \rightarrow 2H2 + CO$ -- (3)
[0029] A reaction formula (1) is a reforming reaction by the methanol and water which are a original fuel, hydrogen (H2) generates it, a reaction formula (2) is oxidation reaction of a methanol, water (H2O) generates it, a reaction formula (3) is the decomposition reaction of a methanol, and the carbon monoxide (CO) of a minute amount generates it. It is endothermic reaction, supply of the heat from the outside is needed, and a reforming reaction (reaction formula (1)) compensates this by the heat of combustion generated by oxidation (reaction formula (2)) of a methanol. Thus, the reformed gas containing hydrogen (fuel), a steam(water), and a carbon monoxide generates.
[0030] At the time of steady operation, this fuel reformer 1 by setting the mole ratio (it being hereafter indicated as a S/C ratio) of the original fuel and water of water fuel mixed gas as the range of 1.5-2.5 Theoretical reaction molar quantity of water [in / for the water vapor content in water fuel mixed gas / a reforming reaction] (by the mole ratio) Original fuel (methanol): Water can be supplied now to the polyelectrolyte film of a fuel cell 51 by making the steam for this excess remain in reformed gas after a reforming reaction, and supplying the reformed gas containing the steam for this excess to a fuel cell 51 as more superfluous than water =1:1.
[0031] While having the catalyst for combustion which is not illustrated, the feeder which supplies the fuel for starting combustion and air and which is not illustrated is attached in the starting combustion section 8. Moreover, a heat exchanger 5 is attached in between the reforming section 4 and CO removal sections 6 (i.e., the downstream of the reforming section 4) through piping 34, and the heat exchanger 7 is attached in the downstream of CO removal section 6 through piping 36 at it. Furthermore, the fuel cell 51 of a solid-state macromolecule mold is connected to the downstream of a heat exchanger 7 through the derivation piping 41.
[0032] A heat exchanger 5 cools the reformed gas supplied from the reforming section 4. It is because the reformed gas to which the reason for having formed the heat exchanger 5 came out of the reforming section 4 is heated by 200 degrees C or more, the operating temperature of latter CO removal section 6 is about 100-150 degrees C, so it is necessary to cool reformed gas at about 100 degrees C. CO removal section 6 is equipped with the selective oxidation catalyst which is not illustrated, and this selective oxidation catalyst is heated by about 100 degrees C, and when the carbon monoxide in reformed gas oxidizes according to this selective oxidation catalyst and a carbon dioxide generates, the carbon monoxide in reformed gas is removed. A heat exchanger 7 cools the reformed gas supplied from CO removal section 6. The reason for having formed the heat exchanger 7 is that it is heated by 150-200 degrees C when reformed gas comes out of CO removal section 6, and it is necessary to cool reformed gas at about 80 degrees C since the operating temperature of the latter fuel cell 51 is about 80-130 degrees C.
[0033] The reformed gas which passed the heat exchanger 7 is supplied to a fuel cell 51 through the derivation piping 41, the hydrogen in reformed gas (fuel) and the oxygen supplied separately cause electrochemical reaction, and a generation of electrical energy is performed. Moreover, the piping 42 from the fuel cell 51 to the combustion section 2 is formed, the exhaust gas containing the unconverted gas discharged from the fuel cell 51 is supplied to the combustion section 2, and a unconverted gas can be burned now in the combustion section 2.
[0034] Moreover, the 3rd thermometer 24 whose 2nd thermometer 23 the 1st thermometer 22 is a temperature detection means in the reforming section 4 at the derivation piping 41 is attached at the evaporation section 3, respectively, and these the 1st, 2, and 3 thermometers 22, 23, and 24 are connected to the control section 25. Moreover, the 1st and 2 fuel injection equipments 12 and 13 which are the 1st and 2 feed zones are connected to the control section 25. This control section 25 controls the 1st and 2 fuel injection equipments 12 and 13 which are adjustment supply means based on the detection temperature of the 3rd thermometer 24, and when detection temperature is below the temperature that can be operated steadily, a original fuel and mixed liquor are made to supply to the evaporation section 3 from the 1st and 2 fuel injection equipments 12 and 13 and detection temperature exceeds the temperature which can be operated steadily, it stops supply of the original fuel by the 1st fuel injection equipment 12. With the temperature which can be operated steadily, the steam contained in reformed

gas is made into the temperature which does not dew at the derivation path 41 of the downstream of the reforming section 4, and is specifically made into 70 degrees C - 80 degrees C here.

[0035] Moreover, the BAIBASU tubing 37 is branched and attached in the derivation piping 41. This by-path pipe 37 is connected to the combustion section 2. And the Mikata bulb 21 is attached in a part for the tee of piping 41 and the bypass piping 37. This Mikata bulb 21 is connected to the control section 25.

[0036] Next, in order to explain actuation of the control section 25 of the fuel reformer 1 for fuel cells, with reference to drawing 1 and drawing 2 , actuation until it results [from starting of the fuel reformer 1] in a steady operation condition is explained. First, in step S1, the memory in a control section 25 is set to an initial value, and the derivation piping 41 and the bypass piping 37 are connected by the Mikata bulb 21. Next, in step S2, each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24 and T3 are read.

[0037] Next, in step S3, it judges whether the detection temperature T2 of the 2nd thermometer 23 which detects the temperature of the reforming section 4 exceeded the reforming initiation temperature Ty in the reforming initiation temperature judging section in a control section 25. Reforming initiation temperature Ty is made into the activation temperature to which a reforming reaction advances in a reforming catalyst, and is set up in 180-250 degrees C. When the detection temperature T2 exceeds the reforming initiation temperature Ty, "1" is inputted into the reforming initiation temperature judging flag F2 in step S4, and when the detection temperature T2 is below the reforming initiation temperature Ty, "0" is inputted into the reforming initiation temperature judging flag F2 in step S6.

[0038] When the reforming initiation temperature judging flag F2 is "0", in step S7, the fuel for starting and air are supplied to the starting combustion section 8, the fuel for starting burns, the starting combustion gas which occurred is sent to the reforming section 4 and its downstream through piping 38, and warming up of the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is carried out.

[0039] Next, in step S8, it judges whether the detection temperature T1 of the 1st thermometer 22 which detects the temperature of the evaporation section 3 exceeded the evaporation initiation temperature Tx in the evaporation initiation temperature judging section in a control section 25. Evaporation initiation temperature Tx is made into temperature with possible making water and a original fuel evaporate in an instant, and is set up in 150-250 degrees C. When the detection temperature T1 exceeds the evaporation initiation temperature Tx, "1" is inputted into the evaporation initiation temperature judging flag F1 in step S9, and when the detection temperature T1 is below the evaporation initiation temperature Ty, "0" is inputted into the evaporation initiation temperature judging flag F1 in step S11.

[0040] When the evaporation initiation temperature judging flag F1 is "0", in step S12, the fuel for combustion burns in the combustion section 2, combustion gas occurs, this combustion gas is sent to the evaporation section 3 and its downstream through piping 32, and warming up of the evaporation section 3, the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is carried out.

[0041] Next, in step S13, it judges whether detection temperature T3 of the 3rd thermometer 24 which detects the temperature of the derivation piping 41 exceeded the steady operation initiation temperature Tz in the steady operation initiation temperature judging section in a control section 25. Temperature Tz which can be operated steadily is made into the temperature which the steam contained in reformed gas does not dew at the derivation path 41, and is specifically made into 70 degrees C - 80 degrees C. When detection temperature T3 exceeds the steady operation initiation temperature Tz, "1" is inputted into the steady operation initiation temperature judging flag F3 in step S14, and when detection temperature T3 is below the steady operation initiation temperature Tz, "0" is inputted into the steady operation initiation temperature judging flag F3 in step S15.

[0042] Next, in step S16, each input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 is judged in the steady operation judging section of a control section 25. When any one input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature

judging flag F2, and the steady operation initiation temperature judging flag F3 is "0", it judges that the fuel reformer 1 is warming-up operational status (when it is F1*F2*F3=0), and progresses to step S20.
[0043] In step S20, warming-up operation mode is chosen and a warm-up is continued. An actuating signal is specifically sent to the 1st and 2 fuel injection equipments 12 and 13 from a control section 25. In the step S22 both, mixed liquor is supplied from the 2nd fuel injection equipment 13. in step S21, a original fuel is supplied to the evaporation section 3 from the 1st fuel injection equipment 12 -- Water fuel mixed gas generates and warming up of the reforming section 4, heat exchangers 5 and 7, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is continued. Moreover, water fuel mixed gas is sent to the combustion section 2 from the bypass piping 37 through a three-way cock 21, the hydrogen in water fuel mixed gas burns, and warming up of the combustion section 2 is carried out.
[0044] Let the S/C ratio of the water fuel mixed gas generated at this time be the range of 0.7-1.2. And air (oxygen) is sent from the starting combustion section 8, while this water fuel mixed gas is sent to the reforming section 4, in the reforming section 4, the reaction shown in above-mentioned reaction-formula (1) - (3) on the reforming catalyst advances, and the reformed gas containing hydrogen generates in it.
[0045] For the reformed gas generated at this time, the molar quantity of the steam with which the S/C ratio of water fuel mixed gas is made into the range of 0.7-1.2, and is supplied to the reforming section 4 is the theoretical reaction molar quantity (it is a mole ratio) of the water in a reforming reaction. Original fuel (methanol) : Since it becomes almost equal to water =1:1, a steam does not remain in reformed gas after a reforming reaction. Even if the temperature of the heat exchangers 5 and 7 in the downstream of the reforming section, CO removal section 6, piping 34, 35, and 36, and the derivation piping 41 is low, dew condensation of a steam does not occur inside these piping or a device.
[0046] Thus, a warm-up is continued and each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24 and T3 go up gradually.
[0047] Next, return, each detection temperature T1 and T2 of the 1st, 2nd, and 3rd thermometer 22, 23, and 24, and T3 are again read into step S2. Next, in step S3, it judges again whether the detection temperature T2 of the 2nd thermometer 23 exceeded the reforming initiation temperature Ty in the reforming initiation temperature judging section in a control section 25.
[0048] If the reforming initiation temperature judging flag F2 is set to "1" for the detection temperature T2 of the 2nd thermometer 23 exceeding the reforming initiation temperature Ty (step S4), in step S5, supply of the fuel for starting to the starting combustion section 8 will be suspended. Thereby, although combustion of the starting combustion section 8 stops, only air is supplied and this air is sent to the reforming section 4 through piping 38.
[0049] Next, in step S8, it judges again whether the detection temperature T1 of the 1st thermometer 22 exceeded the evaporation initiation temperature Tx in the evaporation initiation temperature judging section in a control section 25. If the evaporation initiation temperature judging flag F1 is set to "1" for the detection temperature T1 of the 1st thermometer 22 exceeding the evaporation initiation temperature Tx (step S9), in step S10, supply of the fuel for combustion to the combustion section 2 will be suspended.
[0050] Next, in step S13, it judges again whether detection temperature T3 of the 3rd thermometer 24 exceeded the steady operation initiation temperature Tz in the steady operation initiation temperature judging section in a control section 25. If detection temperature T3 of the 3rd thermometer 24 exceeds the steady operation initiation temperature Tz, the steady operation initiation temperature judging flag F3 will be set to "1" (step S14), and it will progress to step S16.
[0051] In step S16, each input value of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 is again judged in the steady operation judging section of a control section 25. When all the input values of the evaporation initiation temperature judging flag F1, the reforming initiation temperature judging flag F2, and the steady operation initiation temperature judging flag F3 are "1", it is judged that the fuel reformer 1 resulted [from warming-up operational status] in the steady operation condition (when it is F1*F2*F3=1), and it progresses to step S17.
[0052] In step S17, steady operation mode is chosen and steady operation is started. While a stop signal

is sent to the 1st fuel injection equipment 12 from a control section 25 and supply in the evaporation section 3 of the original fuel from the 1st fuel injection equipment 12 makes it specifically stop (step S18), supply of the mixed liquor from the 2nd fuel injection equipment 13 is made to continue (step S19), and **** fuel mixed gas is made to generate. Moreover, the Mikata bulb 21 is changed and the derivation piping 41 is connected with a fuel cell 51. Let the S/C ratio of the water fuel mixed gas generated at this time be the range of 1.5-2.5. And air (oxygen) is sent from the starting combustion section 8, while this water fuel mixed gas is sent to the reforming section 4, in the reforming section 4, the reaction shown in above-mentioned reaction-formula (1) - (3) on the reforming catalyst advances, and the reformed gas containing hydrogen generates in it. It becomes more superfluous [the reformed gas generated at this time] than the theoretical reaction molar quantity (original fuel (methanol): being a mole ratio water = 1:1) of water [in / in the molar quantity of the steam supplied to the reforming section 4 / a reforming reaction], since the S/C ratio of water fuel mixed gas is made into the range of 1.5-2.5, and the steam for this excess will remain in reformed gas after a reforming reaction. The reformed gas containing the steam for this excess is supplied to a fuel cell 51 through CO removal section 6 and the Mikata bulb 21, and water is supplied to the polyelectrolyte film of a fuel cell 51.
[0053] In addition, if the S/C ratio of the water fuel mixed gas at this time (steady operation condition) is 1.5 or less Since a water vapor content falls, the water vapor content which remains in reformed gas decreases and it becomes impossible to supply sufficient water for the polyelectrolyte film of a fuel cell 51, if a S/C ratio exceeds 2.5 preferably Since a water vapor content increases, the steam beyond the need remains in reformed gas and water piles up in piping, device, or fuel cell 51 of the downstream of the reforming section 4, it is not desirable.
[0054] Moreover, since the temperature of the derivation piping 41 is rising to the temperature (temperature which can be operated steadily) which a steam does not already dew, a steam does not dew inside the derivation piping 41. Moreover, if the temperature of the derivation piping 41 is rising to the temperature which can be operated steadily, since the heat exchangers 5 and 7 in the upstream, CO removal section 6, and the temperature of piping 34, 35, and 36 are rising to temperature higher naturally than the derivation piping 41, a steam will not dew inside these piping or a device.

[Translation done.]

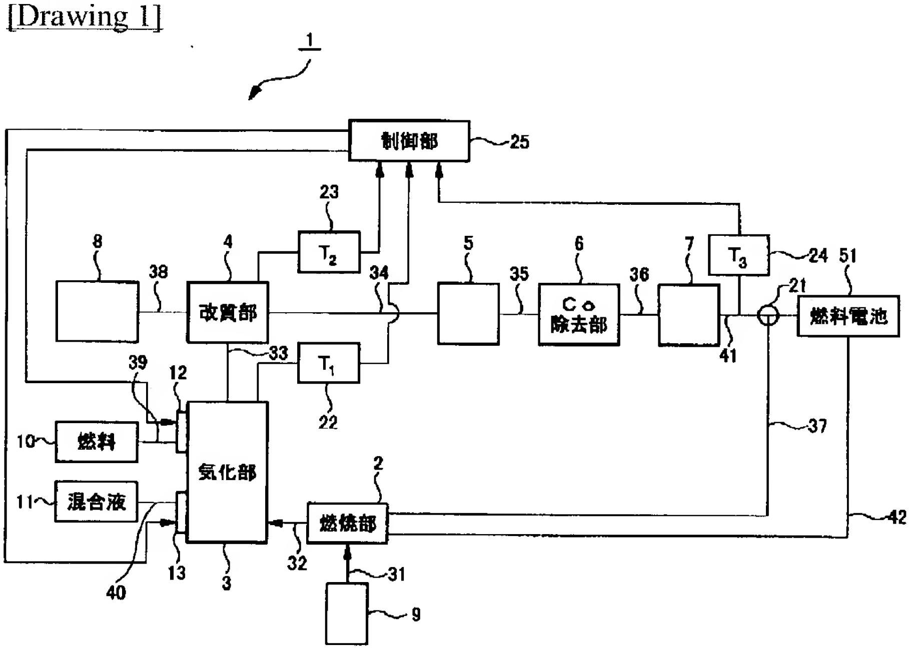
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the fuel reformer for fuel cells which is the operation gestalt of this invention.
[Drawing 2] It is a flow chart for explaining actuation of the control section of the fuel reformer for fuel cells which is the operation gestalt of this invention.
[Drawing 3] It is the block diagram showing the configuration of the conventional fuel reformer for fuel cells.
[Description of Notations]
1 [-- Reforming section,] -- The fuel reformer for fuel cells, 2 -- The combustion section, 3 -- The evaporation section, 4 5 Seven [-- The 1st fuel injection equipment (the 1st feed zone),] -- A heat exchanger, 6 -- CO removal section, 8 -- The starting combustion section, 12 13 [-- The 2nd thermometer, 24 / -- The 3rd thermometer (temperature detection means), 25 / -- A control section (control means), 37 / -- Bypass piping (bypass path) 41 / -- Derivation piping (derivation path) 51 / -- Fuel cell] -- The 2nd fuel injection equipment (the 2nd feed zone), 21 -- A three-way cock (passage selector valve), 22 -- The 1st thermometer, 23

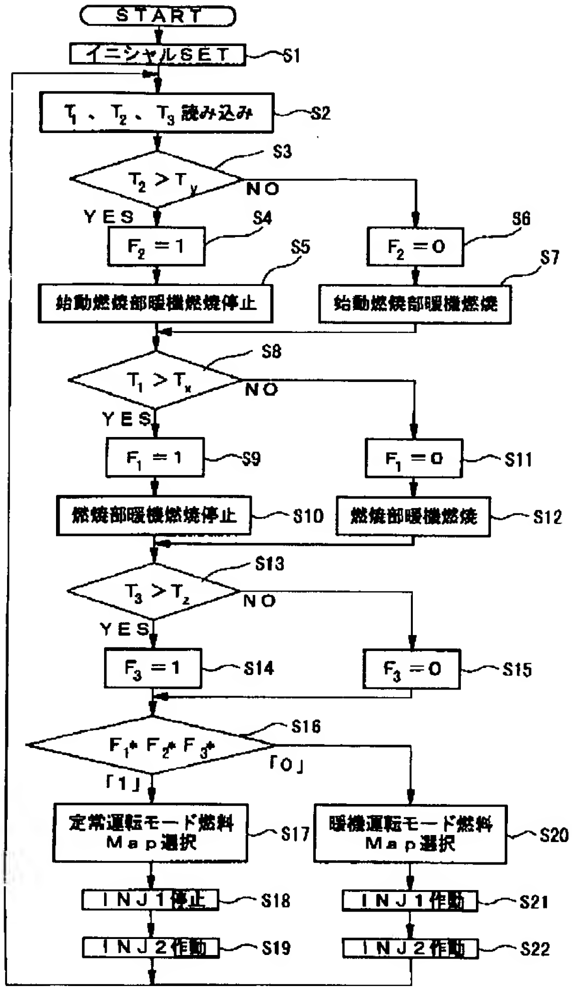
[Translation done.]

DRAWINGS

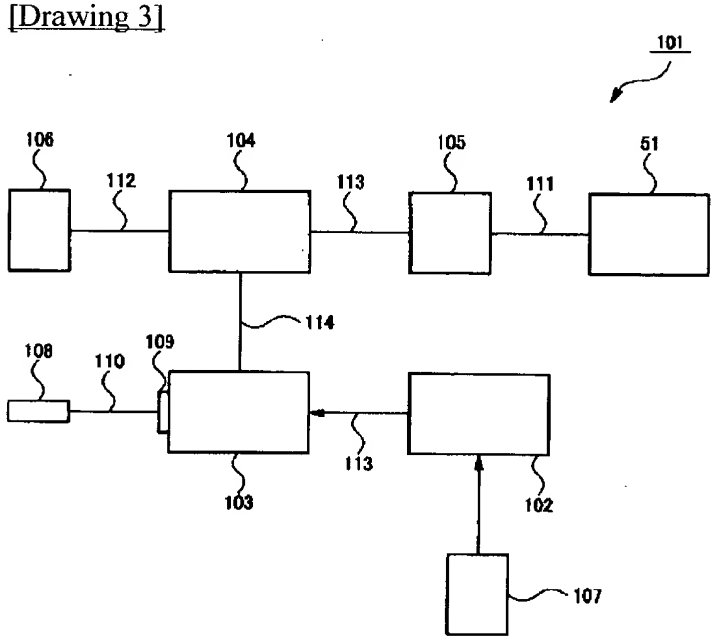
[Drawing 1]



[Drawing 2]


START
イニシャルSET
S1
T1、T2、T3読み込み
S2
S3
T2 > Ty
NO
YES
S4
F2 = 1
S5
始動燃焼部暖機燃焼停止
S6
F2 = 0
S7
始動燃焼部暖機燃焼
S8
T1 > Tx
NO
YES
S9
F1 = 1
S10
燃焼部暖機燃焼停止
S11
F1 = 0
S12
燃焼部暖機燃焼
S13
T3 > Tz
NO
YES
S14
F3 = 1
S15
F3 = 0
S16
F1* F2* F3*
「0」
「1」
定常運転モード燃料 Map選択
S17
暖機運転モード燃料 Map選択
S20
INJ 1停止
S18
INJ 2作動
S19
INJ 1作動
S21
INJ 2作動
S22

[Drawing 3]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